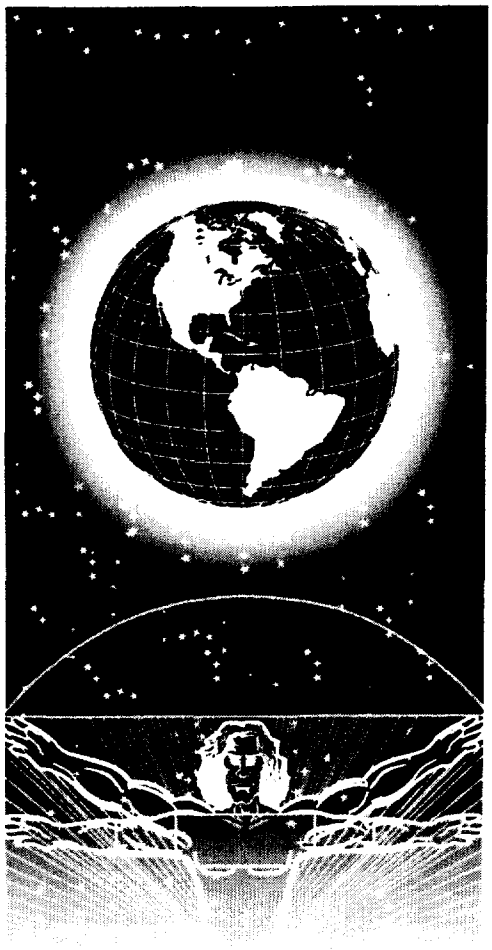
IERA-RS-BR-SR-2001-0010



UNITED STATES AIR FORCE
IERA

Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations

(Revised December 2003)

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January 2002

Approved for public release;

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Air Force Institute for Environment, Safety and Occupational Health Risk Analysis
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2513 Kennedy Circle
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REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	January 2002	Final Oct 00 - Jan 02

4. TITLE AND SUBTITLE
Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations

5. FUNDING NUMBERS

6. AUTHOR(S)
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Mark D. Wade (Karta Technologies, Inc.)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Karta Technologies, Inc.
5555 Northwest Parkway
San Antonio, TX 78249

8. PERFORMING ORGANIZATION REPORT NUMBER
IERA-RS-BR-SR-2001-0010

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air Force Institute for Environment, Safety & Occupational Health Risk Analysis
Risk Analysis Directorate
Environmental Analysis Division
2513 Kennedy Circle
Brooks Air Force Base, TX 78235-5116

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report serves as a guidance document for the preparation of mobile source air emissions inventories at U.S. Air Force installations. Air emissions inventories are prepared at Air Force installations to comply with Federal, State, and local air quality regulatory requirements. Inventories are also used in the implementation of various environmental programs, including pollution prevention opportunities, emissions trading, risk assessments, and environmental auditing. Historically, most air emission inventories performed at U.S. Air Force installations have only targeted stationary sources. However, the need to conduct mobile source air emissions inventories is continually growing due to the increase in regulatory requirements associated with mobile sources. The purpose of this document is to provide a uniform and logical approach for preparing mobile source emissions inventories. The report provides recommended methodologies and emission factors for calculating actual emissions from the most common types of mobile sources found at Air Force installations, including aerospace ground equipment (AGE), aircraft flying operations, on-road vehicles, and nonroad vehicles/equipment. The pollutants addressed in this report include both criteria pollutants and hazardous air pollutants.

14. SUBJECT TERMS
Emissions Inventory Criteria Pollutants Hazardous Air Pollutants Mobile Source
Aerospace Ground Equipment Aircraft Nonroad Vehicles/Equipment
On-road Vehicles Emission Factors Clean Air Act Environmental Protection Agency

15. NUMBER OF PAGES
238

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

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ABBREVIATIONS AND ACRONYMS

AB	afterburner
AFB	Air Force Base
AFIERA	Air Force Institute for Environment, Safety & Occupational Health Risk Analysis
AFIERA/RSEQ	Air Quality & Hazardous Waste Branch of the Air Force Institute for Environment, Safety & Occupational Health Risk Analysis
AFV	alternative fuel vehicle
AGE	aerospace ground equipment
ALVW	adjusted loaded vehicle weight
APCD	Air Pollution Control District
APU	auxiliary power unit
AQM	Air Quality Manager
ATV	all terrain vehicle
BEE	Bioenvironmental Engineer
BSFC	brake-specific fuel consumption
Btu	British thermal unit
°C	degrees Celsius
CAA	Clean Air Act
CAAA-90	Clean Air Act Amendments of 1990
CAFE	corporate average fuel economy
CARB	California Air Resources Board
CES	Civil Engineer Squadron
CFF	clean-fuel fleet
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CFV	clean fuel vehicle
CI	compression ignition
CNG	compressed natural gas
CO	carbon monoxide
CPP	California Pilot Program
CY	calendar year
DF	diesel fuel or deterioration factor
DLA	Defense Logistics Agency
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DTIC	Defense Technical Information Center
EA	environmental assessment
EF	emission factor
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
EPACT	Energy Policy Act
°F	degrees Fahrenheit
FIP	Federal Implementation Plan

FIRE	Factor Information Retrieval System
FR	Federal Register
ft^3	cubic feet
FTP	federal test procedure
g	gram(s)
gal	gallon(s)
GOV	government owned vehicle
GSA	General Services Agency
GVW	gross vehicle weight
GVWR	gross vehicle weight rating
HAP	hazardous air pollutant
HC	hydrocarbons
HCHO	formaldehyde
HDDV	heavy-duty diesel vehicle
HDGV	heavy-duty gasoline vehicle
HDV	heavy-duty vehicle
hp	horsepower
hr	hour(s)
IC	internal combustion
ICAO	International Civil Aviation Organization
ID	identification
I/M	inspection and maintenance
ITR	injection timing retard
kg	kilogram(s)
kW	kilowatt(s)
lb	pound(s)
l	liter
LDDV	light-duty diesel vehicle
LDDT	light-duty diesel truck
LDGV	light-duty gasoline vehicle
LDGT1	light-duty gasoline truck, type 1 (GVW ≤ 6,000 lb)
LDGT2	light-duty gasoline truck, type 2 (GVW between 6,001 and 8,500 lb)
LDT	light-duty truck
LDV	light-duty vehicle
LEV	low-emission vehicle
LFB	low flyby
LFP	low flight pattern
LPG	liquefied petroleum gas
LVW	loaded vehicle weight
LTO	landing and takeoff
MAJCOM	Major Command
MC	motorcycle
MERC	Mobile Emissions Reduction Credit
mg	milligram
mi	mile
min	minute(s)

MMBtu	million British thermal units
MOGAS	motor gasoline
MSDS	material safety data sheet(s)
MTBE	methyl tert-butyl ether
MW	molecular weight
MY	model year
N/A	not applicable
NAAQS	National Ambient Air Quality Standard(s)
ND	no data
NGVC	The Natural Gas Vehicle Coalition
MMHC	non-methane hydrocarbon
NMOC	non-methane organic compound
NMOG	non-methane organic gas
No.	number
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen (or nitrogen oxides)
NREL	National Renewable Energy Laboratory (under DOE)
NSN	national stock number
NTIS	National Technical Information Service
O_3	ozone
OA	opportunity assessment
OEM	original equipment manufacturer
OTAQ	Office of Transportation and Air Quality (under EPA)
P2	pollution prevention
PAH	polycyclic aromatic hydrocarbon(s)
Pb	lead
PIC	products of incomplete combustion
PM	particulate matter
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter less than 10 microns
POL	petroleum, oils, and lubricants
POM	polycyclic organic matter
POV	privately owned vehicle(s)
ppm	parts per million
psi	pounds per square inch
psia	pounds per square inch, absolute
psig	pressure per square inch, gauge
REO	Regional Environmental Office
RFG	reformulated gasoline
RVP	Reid vapor pressure
SCC	source classification code
scf	standard cubic feet
SCR	selective catalytic reduction
SI	spark ignition
SIC	standard industrial classification

SNCR	selective noncatalytic reduction
SO_2	sulfur dioxide
SO_x	oxides of sulfur (or sulfur oxides)
SVOC	semivolatile organic compound(s)
TGO	touch and go
TIM	time in mode
THC	total hydrocarbons
TLEV	transitional low-emission vehicle
TNMOC	total nonmethane organic compound(s)
TOC	total organic compound(s)
tpy	ton(s) per year
TSP	total suspended particulate matter
TW	test weight
ULEV	ultra low-emission vehicle
USAF	United States Air Force
USN	United States Navy
VIN	vehicle identification number
VMT	vehicle miles traveled
VOC	volatile organic compound(s)
wk	week(s)
wt	weight
yr	year(s)
ZEV	zero-emission vehicle

ACKNOWLEGEMENTS

Special thanks and appreciation to Ms. Mary Ruth Senn of the Headquarters Air Combat Command environmental air quality office (HQ ACC/CEVQ) who provided the funding which made development of this document possible.

SECTION 1

INTRODUCTION

1.1 Background and Purpose: The Clean Air Act Amendments of 1990 (CAAA-90) as well as other Federal, State, and local programs have expanded the requirements for industry to quantify and report the amount of air pollutant emissions released into the atmosphere. The quantification of air pollutant emissions from an industrial facility, such as a military installation, is typically accomplished by conducting an air emissions inventory (AEI). In general, an AEI is defined as a compilation of the type and quantity of pollutant emissions over a given period of time, typically one year.

Historically, most AEIs conducted at Air Force installations have only addressed emissions from stationary sources located on the installation, such as boilers, non-portable emergency generators, fuel storage tanks, paint spray booths, solvent degreasing tanks, etc. However, over the last several years, the requirements and benefits associated with conducting AEIs for mobile sources (e.g., on-road motor vehicles, nonroad vehicles/equipment, aircraft, etc.) has continued to grow.

This document was prepared by the Air Quality Branch of the Air Force Institute for Environment, Safety & Occupational Health Risk Analysis (AFIERA/RSEA) as a means of providing a uniform approach to estimating pollutant emissions from the most common types of mobile sources found at Air Force installations. These source types include Aerospace Ground Equipment (AGE), Aircraft, Privately Owned Vehicles, Government Owned Vehicles, and Nonroad Vehicles/Equipment. In addition, this document also provides a brief discussion of a few other "less common" source types (i.e., trains, marine vessels, and missiles/rockets). The document details AFIERA/RSEA's recommended methodologies for calculating actual emissions from these sources. In addition, the document provides the following:

- Summary of regulatory requirements and benefits applicable to mobile source air emissions inventories
- Environmental Protection Agency (EPA) emission factors for the sources addressed
- Example calculations for determining actual emissions for the sources addressed
- Listing of hazardous air pollutants (HAPs)
- List of data elements for the sources addressed

As mentioned above, this document addresses emissions from common Air Force *mobile* sources. Emissions from common Air Force *stationary* sources are addressed in a separate AFIERA document (IERA-RS-BR-SR-1999-0001, "Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations," May 1999). Both documents are available (in PDF format) on AFIERA/RSEA's website:

https://www.afms.mil/afiera/rse/air.htm

Any questions concerning this document, and/or request for additional information pertaining to Air Force air emission inventories, should be directed to the Air Quality personnel at AFIERA/RSEA (Commercial Phone 210-536-3305 or DSN 240-3305).

1.2 Pollutants: Although there are several types (groups/classes) of Federal and State regulated pollutants which may be addressed in an air emissions inventory, this document focuses on the two main pollutant groups regulated under the Clean Air Act: criteria pollutants and hazardous air pollutants. The following is a summary of these two pollutant groups:

a. Criteria Pollutants

Criteria pollutants are usually referred to as the pollutants for which the EPA has established National Ambient Air Quality Standards (NAAQS). These include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter with an aerodynamic diameter $\leq$ 10 microns, particulate matter with an aerodynamic diameter $\leq$ 2.5 microns, and sulfur oxides. However, for the following reasons, the list of "criteria pollutants" for emissions (and emissions inventory) purposes is slightly different than the pollutants regulated by NAAQS:

(1) Ozone is created in the atmosphere (ambient air) through a photochemical reaction involving the following two precursors: volatile organic compounds (VOC) and nitrogen oxides (NO_X).

(2) Nitrogen dioxide (NO_2) in the ambient air is a result of emissions of various nitrogen oxide (NO_X) compounds, not just NO_2.

Based on these items, criteria pollutants for air emissions inventory purposes include the following:

- Carbon Monoxide (CO)
- Lead (Pb)*
- Nitrogen Oxides (NO_X) [Note - NO_X is also referred to as "Oxides of Nitrogen"]
- Particulate Matter with an aerodynamic diameter $\leq$ 10 microns (PM_{10}) [Note - if PM_{10} data is unavailable, Total Particulate Matter (PM) data can be used as a conservative substitute]
- Particulate Matter with an aerodynamic diameter $\leq$ 2.5 microns ($PM_{2.5}$) [Note – since $PM_{2.5}$ was only recently added to the list of criteria pollutants, very limited data is currently available for this pollutant. Therefore, if $PM_{2.5}$ data is unavailable, PM_{10} data (or PM data if no PM_{10} data exists) can be used as a conservative substitute]
- Sulfur Oxides (SO_X) [Note - SO_X is also referred to as "Oxides of Sulfur"]
- Volatile Organic Compounds (VOCs)**

Notes

* Although lead is a criteria pollutant, it is also a hazardous air pollutant. Therefore, to avoid duplication, this document will address lead as a hazardous air pollutant but not as a criteria pollutant.

** The U.S. EPA definition of VOC is found in 40 CFR 51.100. It is also provided in Appendix A of this document.

b. Hazardous Air Pollutants (HAPs)

There are 188 HAPs which are regulated by the EPA and the States pursuant to Section 112(b) of the Clean Air Act (CAA). The HAPs are listed in Section 112(b) of the CAA and the list has been modified twice by the EPA. Changes to the list are found in 40 CFR Part 63, Subpart C. Two listings of the 188 HAPs (one in alphabetical order and the other in CAS number order) are provided in Appendix B of this document.

1.3 Inventory Data Elements: In order to calculate the emissions needed to compile an air emissions inventory, certain input information is required. For example, in order to calculate the emissions from nonroad vehicles/equipment, the following information is typically needed: 1) type of nonroad vehicle/equipment (e.g., forklift, backhoe, lawnmower, etc.) 2) rated power output of the engine associated with the vehicle/equipment; 3) type of fuel used; 4) type of combustion cycle (i.e., 4-stroke or 2-stroke) if vehicle/equipment is gasoline fueled; and either 5) the total time (hours) the vehicle/equipment was in operation during the year; or 6) the quantity (gallons) of fuel consumed by the vehicle/equipment during the year.

Based on the calculation methodologies presented in this document, Appendix C contains a listing of data elements for each mobile source type. If an installation has a requirement to prepare a mobile source air emissions inventory, it's recommended that the Air Quality Manager (AQM) review the listing and contact the applicable shops on base to ensure this data is being recorded.

1.4 Inventory Requirements and Uses:

a. Regulatory Requirements

Air emissions inventories are usually accomplished to meet one or more regulatory requirement(s). The most common regulatory requirements for conducting a mobile source AEI are summarized below:

(1) *General Conformity*

The general conformity program (found under 40 CFR 93) requires all significant Federal actions in nonattainment and maintenance areas to comply with the applicable State or Federal Implementation Plan. The Federal agency responsible for the action is required to perform a determination to verify that the action(s) conform. An emissions inventory is usually required as part of the conformity determination to identify/quantify air emissions associated with the Federal action(s). An air emissions inventory conducted as part of a conformity determination usually addresses both direct and indirect emissions from all pollutant sources (i.e., stationary and mobile) associated with the Federal action(s).

(2) *Implementation Plans*

As specified under Section 110 of the Clean Air Act, all States are required to submit a plan to the EPA which provides for the protection and enhancement of air quality so as to promote public health and welfare. This plan, called a State Implementation Plan (SIP), provides for implementation, maintenance, and enforcement of the National Ambient Air Quality Standards (NAAQS). For areas in the State which are classified as nonattainment with any NAAQS, the SIP must provide strategies for obtaining attainment. For areas in the State which are already classified as being in attainment, the SIP must provide strategies for maintaining attainment status. All SIPs and SIP revisions must be reviewed and approved by the EPA. If the EPA considers a SIP to be incomplete or inadequate, they may issue their own plan called a Federal Implementation Plan (FIP).

Historically, most control strategies incorporated into implementation plans have targeted stationary sources. However, due to the constant increase in the number of air pollution sources, the issuance of new ambient air quality standards, and the fact that mobile sources emit a majority of the overall emissions, more and more control strategies targeting mobile sources are now being incorporated into implementation plans. Since air emission inventories are typically used to assess the effect of control strategies, an increase in the number of control strategies pertaining to mobile sources will result in an increase in requirements to conduct mobile source air emission inventories.

(3) *National Environmental Policy Act (NEPA)*

NEPA requires Federal agencies to evaluate the environmental impacts associated with major actions that they either fund, support, permit, or implement. As part of the NEPA process, an Environmental Assessment (EA) is required if it's determined that the Federal action may potentially have a significant effect on the environment (i.e., can not be categorically excluded). The EA is a study submitted to the EPA that provides background information and preliminary analyses of the potential impact of the proposed Federal action. If the results of the EA indicate that further study of the proposed action is necessary (i.e., a Finding of No Significant Impact is not warranted), then a more comprehensive Environmental Impact Statement (EIS) must be prepared. The EIS addresses all possible impacts (both beneficial and adverse) which may result from the proposed action as well as possible alternatives to the action. Data from air emissions inventories can be used in EAs and EISs to help identify possible environmental consequences associated with air emissions from proposed Federal actions. Typically, all possible sources of air emissions (stationary and mobile) must be evaluated.

(4) *Air Force Instruction (AFI) 32-7040*

AFI 32-7040, "Air Quality Compliance," states the following: "Prepare and periodically update a comprehensive base air emissions inventory. Inventory data will be provided to Federal, State, and local regulatory agencies as required or upon request. Coordinate with Armstrong Laboratory on inventory development and ensure that base emissions inventory data are transferred to the Air Force emissions inventory repository custodian at Armstrong Laboratory."

It's important to note that Armstrong Laboratory no longer exists and that the Air Force emissions inventory repository is maintained by AFIERA/RSEA. A copy of all final emissions inventory reports should be mailed to the following address:

AFIERA/RSEA
(Attn: Air Emission Inventory Custodian)
2513 Kennedy Circle
Brooks AFB TX 78235-5116

It's also important to note that AFI 32-7040 does not specify the type(s) of sources (e.g., just stationary, stationary plus mobile, etc.) which need to be included in the inventory. This is usually based on site-specific requirements, and in some cases, may include mobile sources.

b. Other Inventory Uses

Complying with environmental regulations is not the only reason air emissions inventories are conducted. An air emissions inventory can be a useful tool in helping industrial facilities implement various environmental programs. The most common programs which may involve mobile source emission inventories are summarized below:

(1) *Pollution Prevention (P2) Opportunities* - An air emissions inventory can be a useful tool in identifying air-related P2 opportunities on military installations. The inventory identifies the types of air pollution sources on base as well as the emissions. Due to the large amount of emissions produced from mobile sources, as well as emerging technologies/strategies for reducing mobile source emissions, implementing P2 opportunities for mobile sources is becoming more and more common.

(2) *Emissions Trading* - Some States have adopted emissions trading programs that apply to mobile sources. These programs are usually applicable to fleet vehicles in nonattainment areas. The emissions trading programs allow entities to generate emission reduction credits by converting to low emission vehicles. The credits may be banked, purchased, or traded to meet clean air mandates for specified air programs, or the credits may be sold. Mobile source air emissions inventories typically provide important data needed for calculating mobile emission reduction credits.

(3) *Risk Assessments* - In certain cases it may be necessary to assess the risk(s) which air emissions from a military installation can have on specific public receptors. Data from air emissions inventories can be used in conjunction with approved dispersion models to perform these risk assessments. Due to the large amount of emissions from mobile sources (especially from installations with a high amount of aircraft traffic), as well as the fact that many Air Force installations are located near high population areas, some installations may have a need to conduct risk assessments which include mobile sources.

(4) *Environmental Auditing* - An environmental audit is an objective review of a facility's operations and practices done in order to determine if the facility is meeting its environmental requirements. Audits can be designed to verify compliance with environmental requirements, evaluate the effectiveness of environmental management systems already in place, or assess risks from regulated and unregulated materials and practices. In addition, the audit can be used by management to plan environmental activities for the future. Data from air emissions inventories, including inventories for mobile sources, can be used in the audit process to help identify current and/or potential future air pollution problems associated with a facility's operations and practices.

1.5 References

1. U.S. Air Force Institute for Environment, Safety and Occupational Health Risk Analysis, *Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations*," May 1999.

2. Title 40 Code of Federal Regulations Part 50 (40 CFR 50), *National Primary and Secondary Ambient Air Quality Standards.*

3. Title 40 Code of Federal Regulations Part 51 (40 CFR 51), *Requirements for Preparation, Adoption, and Submittal of Implementation Plans.*

4. Title 40 Code of Federal Regulations Part 93 (40 CFR 93), *Determining Conformity of Federal Actions to State or Federal Implementation Plans.*

5. Federal Clean Air Act, Section 112, *National Emission Standards for Hazardous Air Pollutants.*

6. Engineering-Science, *NEPA Technical Presentation*, AFOEHL Project Management Workshop at Brooks AFB TX, 18 October 1990.

7. Air Force Instruction (AFI) 32-7040, *Air Quality Compliance*, 9 May 1994.

8. Title 30 Texas Administrative Code (TAC) Chapter 114, *Control of Air Pollution from Motor Vehicles.*

SECTION 2

AEROSPACE GROUND SUPPORT EQUIPMENT – NON-VEHICULAR

2.1 Background: The Air Force operates a wide variety of aerospace ground support equipment (AGE) to support flightline and base operations. This equipment is designed to be mobile, so that: 1) it can be used at a wide variety of locations on base; and 2) it can be deployed at any time, and to any location in the world. AGE can be broken out into two categories, non-vehicular AGE (i.e., AGE which is not self-propelled) and vehicular AGE (i.e., AGE which is self-propelled). This section addresses non-vehicular AGE only, while vehicular AGE is covered under Section 7, "Nonroad Vehicles/Equipment."

Non-vehicular AGE consists of equipment such as air compressors, air conditioners, generators, heaters, hydraulic test stands, pumping units, lighting units, welders, concrete saws, arresting barriers, etc. Most AGE is designed to use diesel or JP-8 as fuel. However, there are some types of AGE, such as aircraft arresting barriers, that use gasoline as fuel. It's important to note that although aircraft arresting barriers are a type of non-vehicular AGE, they are usually classified as a stationary source instead of mobile. In general, internal combustion engine equipment (including AGE) which remains in the same location for 12 consecutive months or longer is typically considered to be stationary. That is, if the normal use of a piece of AGE is such that it does not move around an installation at least once during a 12-month period, then the AGE is typically considered stationary. If an air program manager is uncertain about whether a piece of AGE is mobile or stationary, he or she should coordinate with their Major Command (MAJCOM) for assistance. The U.S. Air Force Regional Environmental Offices (REOs) are also valuable resources for assistance in making these determinations. After the MAJCOM and applicable REO have been consulted, the applicable regulatory agency should be contacted to obtain a final determination about whether a particular piece of AGE is mobile or stationary. Such determinations can be very important from a permitting standpoint.

There are two primary types of internal combustion engines which can be used in AGE: reciprocating and gas turbine. With reciprocating engines, a combustible mixture is first compressed in a small volume between the head of a piston and its surrounding cylinder. The mixture is then ignited, and the resulting high-pressure products of combustion push the piston through the cylinder. This movement is converted from linear to rotary motion by a crankshaft. The piston returns, pushing out exhaust gases, and the cycle is repeated.

There are two methods used for stationary reciprocating internal combustion engines: compression ignition (CI) and spark ignition (SI). Diesel-fueled engines are compression ignited while natural gas and gasoline-fueled engines are spark ignited. In CI engines, combustion air is first compression heated in the cylinder, and diesel fuel is then injected into the hot air. Ignition is spontaneous because the air temperature is above the autoignition temperature of the fuel. SI engines initiate combustion by the spark of an electrical discharge. Usually the fuel is mixed with the air in a carburetor (for gasoline) but occasionally the fuel is injected into the compressed air in the cylinder.

Reciprocating engines are also separated into different design classes: 2-stroke lean burn, 2-stroke ultra lean (clean) burn, 4-stroke lean burn, 4-stroke clean burn, and 4-stroke rich burn.

Each of these have design differences that affect both uncontrolled emissions as well as the potential for emissions control. Two-stroke engines complete the power cycle in a single crankshaft revolution as compared to the two crankshaft revolutions required for 4-stroke engines.

In a 2-stroke engine, the air/fuel charge is injected with the piston near the bottom of the power stroke. The intake ports are then covered or closed, and the piston moves to the top of the cylinder, thereby compressing the charge. Following ignition and combustion, the power stroke starts with the downward movement of the piston. Exhaust ports or valves are then uncovered to exhaust the combustion products, and a new air/fuel charge is injected.

Four-stroke engines use a separate engine revolution for the intake/compression cycle and the power/exhaust cycle. These engines may be either naturally aspirated, using the suction from the piston to entrain the air charge, or turbocharged, using an exhaust-driven turbine to pressurize the charge. Turbocharged units produce a higher power output for a given engine displacement, whereas naturally aspirated units have lower initial cost and maintenance. Rich burn engines operate near the stoichiometric air/fuel ratio with exhaust excess oxygen levels less than 4 percent. Lean burn engines may operate up to the lean flame extinction limit, with exhaust oxygen levels of 12 percent or greater.

Gas turbines are essentially composed of three major components: compressor, combustor, and power turbine. Ambient air is drawn in and compressed up to 30 times ambient pressure and directed to the combustor section where fuel is introduced, ignited, and burned. The hot expanding exhaust gases are then passed into the power turbine to produce usable shaft energy (note - more than 50 percent of the shaft energy produced is needed to drive the internal compressor. The balance is available to drive an external load, such as an electric generator).

2.2 Emission Calculations: To calculate emissions from AGE, you will need to know the AGE application (model number and equipment type), the manufacturer, model number, and horsepower rating of the engine, the typical operating horsepower, and either the volume of fuel burned or the hours of operation. This data can then be used (in conjunction with Environmental Protection Agency emission factors, Air Force emission test data, and/or manufacturer supplied emission rates) to calculate emissions. Unfortunately, there are currently no hazardous air pollutant (HAP) emission factors for reciprocating engines running on JP-8 fuel. Therefore, AFIERA/RSEA recommends using the diesel fuel HAP emission factors for engines running on JP-8.

There are several methods that can be used to calculate AGE emissions. Which method to use is usually dependent on what information is available. The following is a summary of the different methods:

a. Method 1

The first method for calculating emissions is to convert the fuel consumption into horsepower-hour, and then multiply that figure times the appropriate emission factor. The following equation is used:

$$E_{pol} = [(FC * HV) / HP_{Btu}] * (EF / 453.59)$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
FC = Fuel consumption (gal/yr)
HV = Heating value of the fuel (Btu/gal), see Table 2-1
HP_{Btu} = Btu per horsepower-hour (Btu/hp-hr) [note: typical value is 7,500]
EF = Emission factor in grams per horsepower hour (g/hp-hr)
453.59 = Conversion factor to convert grams to pounds (g/lb)

Table 2-1. Typical Heating Values for Various Fuels

Type of Fuel	Typical Heating Value (Btu/gal)
Diesel	137,000
JP-8	135,000
Gasoline	130,000

b. Method 2

The second method involves multiplying the number of hours that the AGE operates times the typical horsepower load that the engine operates at in the field. The total horsepower-hours are then multiplied times the appropriate emission factor. The following equation is used:

$$E_{pol} = EL_{HP} * OT * EF / 453.59$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
EL_{HP} = Typical horsepower load which the engine operates at (hp)
OT = Operating time (hr/yr)
EF = Emission factor (g/hp-hr)
453.59 = Conversion factor to convert grams to pounds (g/lb)

If the typical engine load (EL_{HP}) is unknown, it can be estimated by multiplying the maximum rated horsepower of the engine times a typical load factor. The following equation is used:

$$EL_{HP} = MRH * (LF / 100)$$

Where,

MRH = Maximum rated horsepower of the engine (hp)
LF = Typical load factor (%), see Table 2-2
100 = Factor for converting percent to a fraction

Table 2-2. Typical Load Factors for Internal Combustion Engine Equipment

Equipment Type	Diesel Load Factor (% of Max. Power)	Gasoline Load Factor (% of Max. Power)
Generator Sets	74	68
Air Compressors	48	56
Gas Compressors	60	60
Pumps	74	69
Aircraft Support	51	56
Aerial Lifts	46	46
Refrigeration/AC	28	46
Welders	45	51

c. Method 3

The third method involves multiplying the volume of fuel consumed times an emission factor which is based on mass of pollutant emitted per volume of fuel consumed. This method is typically used for AGE which are not specifically listed in Table 2-3, or if there is a need to calculate HAP emissions. The following equation is used in conjunction with the emission factors in Tables 2-4 through 2-8.

$$E_{pol} = (FC / 1000) * EF$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
FC = Fuel consumption (gal/yr)
1000 = Factor for converting gallons into thousands of gallons
EF = Emission factor (lb/1000 gal of fuel burned)

It's important to note that in some cases the fuel consumption is unknown. However, it may be possible to estimate the fuel consumption based on the typical horsepower load of the engine, the hours of operation, Btu per horsepower-hour conversion, and the heating value of the fuel. The following equation is used:

$$FC = (EL_{HP} * OT * HP_{Btu}) / HV$$

Where,

FC = Fuel consumption (gal/yr)
EL_{HP} = Typical horsepower load which the engine operates at (hp) [note: if unknown, see Method 2 above for estimating it]
OT = Operating time (hr/yr)
HP_{Btu} = Btu per horsepower-hour (Btu/hp-hr) [note: typical value is 7,500]
HV = Heating value of the fuel (Btu/gal), see Table 2-1

Criteria pollutant emission factors for specific types of reciprocating AGE are provided in Table 2-3. These factors were either derived from individual emission tests or were provided by the engine manufacturers. All emission factors in this table are in units of grams pollutant emitted per horsepower-hour output.

For reciprocating AGE that are not listed in Table 2-3, EPA emission factors can be used. General EPA emission factors for diesel fueled and gasoline fueled reciprocating engines are provided in Tables 2-4 and 2-5, respectively. In addition to criteria pollutant emission factors, Table 2-4 also provides HAP emission factors for diesel engines.

Emission factors for specific types of turbine AGE are provided in Tables 2-6 and 2-7. Table 2-6 contains emission factors for criteria pollutants, while Table 2-7 contains emission factors for AGE. All emission factors in these two tables were derived from emission test data, and are in units of pounds pollutant emitted per thousand gallons of fuel combusted.

For turbine AGE that are not listed in Tables 2-6 and 2-7, EPA emission factors can be used. General EPA emission factors for diesel fueled turbine engines are provided in Table 2-8.

2.3 Information Resources: The AGE shop is in charge of the repair and operation of most pieces of AGE. Therefore, they should be able to provide most, if not all, the information needed to calculate the emissions from the AGE used on the installation. In some cases, the AGE manufacturer may need to be contacted for additional information.

An example of a data collection form which can be used to collect data on AGE is provided in Figure 2-1.

2.4 Example Calculations: An AM32A-86D generator consumed 250 gallons of JP-8 during a calendar year. Calculate the annual NO_X and formaldehyde emissions from the generator.

Since the AM32A-86D generator is listed in Table 2-3 and the fuel consumption is known, NO_X emissions can be calculated using Method 1 described in subsection 2.2 above:

E_{pol} = [(FC * HV) / HP_{Btu}] * (EF / 453.59)
E_{NOx} = [(250 gal/yr * 135,000 Btu/gal) / 7,500 Btu/hp-hr] * (18.7 g/hp-hr / 453.59 g/lb)
= **185 lb/yr**

Since formaldehyde is a HAP, emissions of formaldehyde are calculated using Method 3 described in subsection 2.2 above. The first step is to determine if a specific formaldehyde emission factor for the AM32A-86D exists, or if a general EPA emission factor must be used. The only specific HAP emission factors for AGE are listed in Table 2-7 and apply to turbine AGE only. Since the AM32A-86D has a reciprocating engine, there are currently no specific HAP emission factors for it. Therefore, the general EPA emission factor found in Table 2-4 will be used.

$$E_{pol} = (FC / 1000) * EF$$
$$E_{formaldeyhde} = (250 \text{ gal/yr} / 1000) * 0.162 \text{ lb/1000 gal}$$
$$= \mathbf{0.04 \text{ lb/yr}}$$

Table 2-3. Emission Factors for Specific Types of Non-Vehicular Aerospace Ground Support Equipment

Application	Source of Data[a]	Engine Manufacturer	Model Number	Rated Hp	Fuel	Operational Mode	Fuel Flowrate (gal/hr)	Emission Factors (g/hp-hr)			
								NO_X	CO	VOC[b]	PM_{10}
Generator Set	1	Caterpillar	D3333T	214	Diesel/JP-8	100% Load	17.5	6.72	1.46	1.16	0.15
						62% Load	10.46	6.5	1.31	1.58	0.17
A/M32C-18 Air Compressor	1	Detroit Diesel	6V71T	290	Diesel/JP-8	100% Load	16.57	12.47	2.38	0.32	0.33
A/M32A-86 Generator	2	Detroit Diesel	4-71N	148	Diesel/JP-8	All Loads	6.47	18.7	1.4	0.9	0.28
Elevator Loader	1	Detroit Diesel	3-53 Series	110	Diesel/JP-8	100% Load	6.29	12.9	4.32	0.53	0.26
MJ-1-1 Hydraulic Test Stand	1	Detroit Diesel	3-53 N	97	Diesel/JP-8	All Loads	2.52	3.54	0.2	0.12	ND
MJ-2 & TTU-228 Hydraulic Test Stands	3	Detroit Diesel	6V-53N	125	Diesel/JP-8	All Loads	4.92	3.4	0.3	1.06	0.3
MJ-2 & TTU-229 Hydraulic Test Stands	1	Detroit Diesel	6V-53N	125	Diesel/JP-8	100% Load	10.86	14	8.95	0.7	0.3
MJ-2 & TTU-228 Hydraulic Test Stands	1	Detroit Diesel	4-53	130	Diesel/JP-8	100% Load	7.43	11.85	2.77	0.68	0.31
Ground Mobil Terminal Gen Set	1	Detroit Diesel	4-71-T	150	Diesel/JP-8	100% Load	8.57	20.73	3.37	0.47	0.33
Trielectron D200T400 175 KW Generator Set	3	Detroit Diesel	8V-71T	236	Diesel/JP-8	All Loads	10.9	16.57	0.42	0.52	0.4
R-22 Pumping Unit	1	Detroit Diesel	3-53 Series	110	Diesel/JP-8	100% Load	6.29	12.9	4.32	0.53	0.26
Ace 802-3293 Air Conditioner	3	Detroit Diesel	6V71N	272	Diesel/JP-8	All Loads	6.8	4.9	0.25	0.34	0.33
B-1B Air Conditioner	1	Detroit Diesel	6V-92TA	300	Diesel/JP-8	100% Load	17.14	11.58	2.13	0.39	0.23
EMU-17 Gen Set	1	Detroit Diesel	12V-71N	300	Diesel/JP-8	100% Load	17.14	13.4	16.75	0.51	0.28
EMU-15 Gen Set	1	Detroit Diesel	3-71	100	Diesel/JP-8	100% Load	5.71	15.9	22.25	0.43	0.52
MC-5 Air Compressor	3	Deutz	F4L912 4CYL	100	Diesel/JP-8	All Loads	2.38	2.48	1.51	0.5	ND
Miller Concrete Cutter	1	Deutz	BF4D-1011T	75	Diesel/JP-8	All Loads	4.45	6.3	1.2	0.5	ND
MC-8 Air Compressor	1	Deutz	F6L912	110	Diesel/JP-8	All Loads	6.52	12.3	3.1	0.5	ND
MC-5 Air Compressor	1	GMC	Series 4-53	130	Diesel/JP-8	100% Load	7.43	11.85	2.77	0.68	0.31
MC-1A Air Compressor	1	Hatz	Z790-193	18.4	Diesel/JP-8	All Loads	1.09	10.33	6.57	6.57	1.74
MC11 Air Compressor	1	Hatz	Z790-193	18.4	Diesel/JP-8	All Loads	1.09	10.33	6.57	6.57	1.74

Table 2-3. Emission Factors for Specific Types of Non-Vehicular Aerospace Ground Support Equipment (Cont'd)

Application	Source of Data[a]	Engine Manufacturer	Model Number	Rated Hp	Fuel	Operational Mode	Fuel Flowrate (gal/hr)	Emission Factors (g/hp-hr)			
								NO_X	CO	VOC[b]	PM_{10}
MC7 Air Compressor	1	John Deere	3164D	52	Diesel/JP-8	100% Load	3.3	11.21	5.6	0.5	ND
MC7 Air Compressor	3	John Deere	3179 SPEC FD16694J	48	Diesel/JP-8	All Loads	1.8	3.91	0.17	0.5	ND
MA-3D Air Conditioner	1	John Deere	4045T	120	Diesel/JP-8	All Loads	7.12	15.75	1.2	0.2	ND
MA-3D Air Conditioner	3	John Deere	4039T	110	Diesel/JP-8	All Loads	4.57	2.64	0.24	1.17	0.26
MC-5 Air Compressor	1	John Deere	4039	110	Diesel/JP-8	All Loads	6.52	10	2	0.3	ND
EMU-19/U Gen Set	1	Lister	ST-3	30	Diesel/JP-8	All Loads	1.78	11.24	5.31	4.02	ND
MC-1A Air Compressor	1	Lister Engineering Co.	ST2A/MC1A	20	Diesel/JP-8	All Loads	1.19	11.24	5.31	4.02	ND
BT400-46 Heater	1	Lister-Petter	AC1-389548	6.5	Diesel/JP-8	All Loads	0.39	11	12.6	6.97	ND
MA3 Air Conditioner	1	Onan	L643T*I/1C178-C	65	Diesel/JP-8	All Loads	3.79	3.47	0.93	0.08	ND
Generator Light Cart	4	Onan	P218G-I/10876C	10.5	Diesel/JP-8	All Loads	0.62	7.8	6	ND	7.5
PMU-27/M	1	Petter Diesel Eng Co.	AC1 One CYL	6.5	Diesel/JP-8	All Loads	0.39	11	12.6	6.97	ND
Type AH-1 Heater 35E7-11-11	1	Petter Diesel Engine	AC-1	6.5	Diesel/JP-8	All Loads	0.39	11	12.6	6.97	ND
PMU 27/M Pumping Unit	1	Petter Diesel Engine	AC-1	6.5	Diesel/JP-8	All Loads	0.39	11	12.6	6.97	ND
Arrest Barrier/ACFT	1	Teledyne Total Power	V-465D	64	Gasoline	100% Load	3.9	2.67	207	2.26	ND
AF/M27M-1Pumping Unit	1	Wisconsin	VH4D	30	Gasoline	100% Load	1.78	2.67	185.4	4.18	ND
MC11 Air Compressor	1	Wisconsin	MVH4D	30	Gasoline	100% Load	1.78	2.67	185.4	4.18	ND
BAK-13 Arresting Barrier	1	Wisconsin	MV-465D	64	Gasoline	100% Load	3.9	2.67	207	2.26	ND

[a] Sources of data include the following:

1. Emission factors were obtained from the manufacturer. Fuel usage rates were based on 7,500 Btu/hp-hr.
2. Emission factors were obtained from the Southwest Research Institute report titled: "Exhaust Emissions from a USAF A/M32-86D Generator"
3. Emission factors were obtained from the Pacific Environmental Services report titled: "Aerospace Ground Support Equipment Emissions Characterization for Edwards AFB, California"
4. Emission Factors are EPA Tier I Non-road Engine Factors.

[b] VOC emission factors are based on values for total hydrocarbons.

ND = No Data

Table 2-4. EPA Emission Factors for Uncontrolled Diesel Reciprocating Internal Combustion Engines[a]

Pollutant	Emission Factor (lb/10^3 gal)[b]	Emission Factor (lb/10^3 hp-hr)[c]
Criteria Pollutants		
CO	130	6.68
NO_X	604	31
PM[d]	42.5	2.2
PM_{10}[d]	42.5	2.2
SO_X	39.7	2.05
VOC[e]	49.3	2.5
Hazardous Air Pollutants		
Acetaldehyde	0.105	5.40E-03
Acrolein	0.013	6.48E-04
Benzene	0.128	6.50E-03
1,3-Butadiene	0.005	2.74E-04
Formaldehyde	0.162	8.30E-03
Naphthalene	0.012	5.94E-04
Polycyclic Aromatic Hydrocarbons (PAH)[f]	0.023	1.20E-03
Toluene	0.056	2.90E-03
Xylenes	0.039	2.00E-03

[a] Applies to diesel reciprocating internal combustion engines with a rated power up to 600 horsepower (447 kilowatts). Applicable Source Classification Codes (SCCs) include 2-02-001-02 and 2-03-001-01.

[b] Pounds pollutant emitted per thousand gallons of fuel burned. These emission factors are from the EPA's FIRE program. The "lb/10^3 gal" HAP emission factors were calculated by multiplying the "lb/MMBtu" emission factors listed in FIRE times the typical heating value of diesel fuel (137 MMBtu/10^3 gal).

[c] Pounds pollutant emitted per thousand horsepower-hour (power output). These emission factors are from Section 3.3 of AP-42. The "lb/10^3 hp-hr" HAP emission factors were calculated by multiplying the "lb/MMBtu" emission factors listed in AP-42 times an average brake-specific fuel consumption (BSFC) value of 7 MMBtu/10^3 hp-hr.

[d] All particulate is assumed to be less than 1 μm in size.

[e] Based on the emission factor for Total Organic Compounds (TOC).

[f] For inventory purposes, assume PAH is the same as Polycyclic Organic Matter (POM).

Table 2-5. EPA Emission Factors for Uncontrolled Gasoline Internal Combustion Engines[a]

Pollutant[b]	Emission Factor ($lb/10^3$ gal)[c]	Emission Factor ($lb/10^3$ hp-hr)[d]
CO	7,900	439
NO_X	205	11
PM[e]	12.6	0.721
PM_{10}[e]	12.6	0.721
SO_X	10.6	0.591
VOC[f]	382	21.6

[a] Applicable Source Classification Codes include 2-02-003-01 and 2-03-003-01.

[b] No emission factors are currently available for hazardous air pollutants emitted from this source category.

[c] Pounds pollutant emitted per thousand gallons of fuel burned. These emission factors are from the EPA's FIRE Program.

[d] Pounds pollutant emitted per thousand horsepower-hour (power output). These emission factors are from Section 3.3 of AP-42.

[e] All particulate is assumed to be less than 1 μm in size.

[f] Based on the emission factor for Total Organic Compounds (TOC).

Table 2-6. Uncontrolled Criteria Pollutant Emission Factors for Specific Types of Diesel/JP-8 Turbine AGSE

Application	Turbine Manufacturer	Source of Data[b]	Emission Factors (lb/1000 gal)[a]			
			NO_X	CO	VOC[c]	PM
EMU-30E, 36E	Sundstrand T62-T-32	1	27	290	600	ND
MA-1A, 2 & MB-2, 3	Allied Signal GTCP85-70A	2	34	64.3	0.9	5.3
A/M32A-60	Allied Signal GTCP85-397	3	30	140	0.3	5
A/M32A-60A	Garrett GTCP85-180	4	40	160	2	3
A/M32A-95	Garrett GTCP85-180	4	40	160	2	3

[a] Emission factors are in units of pounds pollutant emitted per thousand gallons of fuel burned.

[b] Sources of data include the following:

1. Engine manufacturer's data.
2. Radian Corporation report titled "Emissions Testing Report for Aircraft Ground Support Units" (May 1995).
3. Pacific Environmental Services report titled "Development of Emission Factors for Selected Aircraft Ground Equipmen at March AFB, California" (June 1995).
4. Pacific Environmental Services report titled: "Aerospace Ground Support Equipment Emissions Characterization for Edwards AFB, California"

[c] Based on values for total hydrocarbons.

ND = No Data

Table 2-7. Uncontrolled HAP Emission Factors for Specific Types of Diesel/JP-8 Turbine AGSE

HAP	Emission Factors by Application Type (lb/1000 gal)[a]				
	EMU-30E, 36E	MA-1A, 2 & MB-2, 3[b]	A/M32A-60[c]	A/M32A-60A[c]	A/M32A-95[c]
Acetaldehyde	ND	ND	2.09×10^{-3}	2.09×10^{-3}	2.09×10^{-3}
Acrolein	ND	ND	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
Benzene	ND	1.3×10^{-5}	1.5×10^{-2}	1.5×10^{-2}	1.5×10^{-2}
Ethlbenzene	ND	1.1×10^{-6}	8.78×10^{-4}	8.78×10^{-4}	8.78×10^{-4}
Formaldehyde	ND	ND	2.03×10^{-2}	2.03×10^{-2}	2.03×10^{-2}
Toluene	ND	6.6×10^{-6}	4.36×10^{-3}	4.36×10^{-3}	4.36×10^{-3}
Xylenes	ND	4.8×10^{-6}	2.69×10^{-3}	2.69×10^{-3}	2.69×10^{-3}

[a] Emission factors are in units of pounds pollutant emitted per thousand gallons of fuel burned.

[b] Emission factors from the Radian Corporation report titled "Emissions Testing Report for Aircraft Ground Support Units" (May 1995).

[c] Emission factors are for the GTCP85-180 turbine listed in the Environmental Quality Management Inc. / Roy F. Weston Inc. report titled "Aircraft Engine and Auxiliary Power Unit Emissions Testing" (December 1998).

ND = No Data

Table 2-8. EPA Emission Factors for Uncontrolled Diesel Turbine Internal Combustion Engines[a]

Pollutant	Emission Factor ($lb/10^3$ gal)[b]
Criteria Pollutants	
CO	0.46
NO_X	122
PM[c]	1.67
PM_{10}[c]	1.67
SO_X[d]	140S
VOC	0.057
Hazardous Air Pollutants	
Arsenic	1.53E-03
Benzene	7.65E-03
Beryllium	4.31E-05
1,3-Butadiene	2.22E-03
Cadmium	6.67E-04
Chromium	1.53E-03
Formaldehyde	3.89E-02
Lead	1.95E-03
Manganese	1.10E-01
Mercury	1.67E-04
Naphthalene	4.87E-03
Nickel	6.39E-04
Polycyclic Aromatic Hydrocarbons (PAH)[e]	5.56E-03
Selenium	3.48E-03

[a] Applicable Source Classification Codes (SCCs) include 2-01-001-01, 2-02-001-01, 2-02-001-03 and 2-03-001-02.

[b] Pounds pollutant emitted per thousand gallons of fuel burned. These emission factors are from Section 3.1 of AP-42. The "$lb/10^3$ gal" HAP emission factors were calculated by multiplying the "lb/MMBtu" emission factors times the typical heating value of distillate fuel (139 $MMBtu/10^3$ gal).

[c] All particulate is assumed to be less than 10 μm in size.

[d] The SO_X emission factor is based on the sulfur content of the fuel, with S equal to percent sulfur. For example, if the sulfur content of the fuel is 0.5%, the emission factor would be: $140(0.5) = 70$ $lb/10^3$ gal

[e] For inventory purposes, assume PAH is the same as Polycyclic Organic Matter (POM).

Figure 2-1. Example Data Collection Form for Aerospace Ground Support Equipment (AGE)

Installation Name: **Inventory Year (CY):**
Responsible Organization (Name & Office Symbol):
POC (Name & Phone #):

Equipment Type/Name	Equipment Use	Engine Manufacturer	Engine Model No.	Fuel Type	Horsepower Rating (hp)	Typical Operating Load *	Estimated Operating Time (hr/yr)	Estimated Fuel Usage (gal/yr)

* This is the typical load which the equipment was operated at during the inventory year. This may be listed as a horsepower value, percentage (i.e., percent of maximum power), or description. Be sure to specify.

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2.5 References

1. Southwest Research Institute, *Exhaust Emissions from a USAF A/M32A-86D Generator*, June 1998.

2. Pacific Environmental Services Inc., *Aerospace Ground Support Equipment Emissions Characterization for Edwards AFB, California*, September 1997.

3. Engine manufacturer's data supplied by Caterpillar, Detroit Diesel, Duetz, Garrett, Hatz, John Deere, Lister Petter, Onan, and Wisconsin. November 2000.

4. United States Air Force IERA, *Air Force Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations* (Section 29), May 1999.

5. Radian Corporation, *Emissions Testing Report for Aircraft Ground Support Units*, May 1995.

6. Environmental Quality Management Inc. and Roy F. Weston Inc., *Aircraft Engine and Auxiliary Power Unit Emissions Testing*, December 1998.

7. Pacific Environmental Services Inc., *Development of Emission Factors for Selected Aircraft Ground Equipment at March AFB California*, June 1995.

8. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors - Volume I: Stationary Point and Area Sources* (AP-42), Section 3.1, April 2000.

9. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors - Volume I: Stationary Point and Area Sources* (AP-42), Section 3.3, October 1996.

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SECTION 3

AIRCRAFT ENGINE EMISSIONS

3.1 Background: Depending on the operation, aircraft engine emissions can be classified as either mobile or stationary. Landing and takeoff (LTO), touch and go (TGO), low flyby (LFB), low flight pattern (LFP), trim pad, and on wing engine testing emissions are typically considered mobile source emissions. Emissions from off wing engine tests (e.g., testing of engines in test cells or on outdoor test pads) are usually considered stationary source emissions. Auxiliary power unit (APU) emissions are often overlooked. The emissions generated from the operation of APUs while mounted in the aircraft are mobile emissions. The emissions from testing APUs in test cells are usually considered stationary source emissions since the APUs are removed from the aircraft prior to testing. Only mobile source emissions are discussed in this document. Aircraft engine emissions from stationary sources are discussed in the AFIERA report, "Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations," dated May 1999.

LTO emissions are the emissions that are generated by an aircraft during a landing and takeoff cycle. The cycle time components (modes) include aircraft approach, taxi/idle-in, taxi/idle-out, takeoff, and climbout. The approach component is measured from the moment the aircraft enters the atmospheric mixing zone until the aircraft lands. The taxi/idle-in component is the time spent after landing until the aircraft is parked and turned off. The taxi/idle-out component is the period of time from engine startup to takeoff. Takeoff, which is characterized by full throttle, lasts until the aircraft reaches an altitude of 500 to 1000 feet. Climbout is the period following takeoff that concludes when the aircraft passes out of the mixing zone. The mixing zone is defined as the layer of the earth's atmosphere where chemical reactions of pollutants can ultimately affect ground level pollutant concentrations. The height of the mixing zone can vary significantly with location and time of season. Therefore, when conducting a mobile source air emissions inventory at an installation, it is highly recommended that the average mixing zone height specific to that installation be determined.

TGOs and LFBs are similar to LTOs, except they do not include the taxi/idle-in or taxi/idle-out modes. In addition, the takeoff times during these operations may differ slightly from the LTO takeoff times. LFPs are aircraft flight patterns which occur below the average atmospheric mixing height. LFPs typically involve a constant power setting, although the use of more than one power setting is possible. In most cases, the LFPs of importance are those which occur within base air space (i.e., over base property at an altitude that is below the average mixing zone height). However, if a "regional" air emissions inventory is being conducted (as opposed to a base air emissions inventory), the LFPs which occur outside (adjacent to) base air space will also need to be addressed.

Testing of aircraft engines is performed at most Air Force installations (i.e., those with flying missions) on a routine and as needed basis. Testing is necessary to ensure proper engine operation prior to fight, especially after any maintenance has been performed. Engine tests may last anywhere from 15 minutes to several hours, depending on the nature of the engine problems.

Emissions from testing aircraft engines while they are mounted on the aircraft (i.e., in a hush house or at a trim pad) are usually considered mobile emissions.

However, when considering if a source of emissions is mobile or stationary, it's important to note that some State/local regulatory agencies may have a different interpretation. If an air program manager is uncertain about whether a particular aircraft engine testing activity is mobile or stationary, he or she should coordinate with their Major Command (MAJCOM) for assistance. The U.S. Air Force Regional Environmental Offices (REOs) are also valuable resources for assistance in making these determinations. After the MAJCOM and applicable REO have been consulted, the applicable regulatory agency should be contacted to obtain a final determination about whether a particular aircraft engine testing activity is mobile or stationary. Such determinations can be very important from a permitting standpoint.

Emissions of concern from aircraft engine testing operations include the criteria pollutants and various HAPs. During the last few years, the Air Force has performed emissions sampling on a variety of aircraft engines, as well as a few APUs, while burning JP-8 or JP-5 fuel. The results of this sampling and previous similar engine emissions tests have been combined to generate new emission factors for most Air Force aircraft engines and APUs. The new emission factors are included in this section.

Aircraft engines are typically operated at up to five different power settings. These power settings are usually identified using the following terminology: Idle, Approach, Intermediate, Military, and Afterburner. Helicopter engines are typically operated at Ground Idle, Flight Idle, Normal, Military, and sometimes Overspeed. APUs are operated at either no load, or at constant load (typically maximum load). The emission factors provided in this section are for the common power settings applicable to each engine. The corresponding fuel flow rate listed for each engine power setting is the fuel rate used during the emissions sampling to derive the emission factors. The actual fuel rates used during aircraft operation and aircraft engine testing at individual Air Force installations may differ slightly. If known, the actual fuel rates used by the base during aircraft operation and engine testing should be used to select the most appropriate set of emission factors and to determine the volume of fuel burned at each power setting. This information will provide the most accurate emissions calculations.

A list of U.S. Air Force aircraft and associated engines is provided in Table 3-1. A list of U.S. Air Force aircraft which use APUs, as well as the APU designations, is provided in Table 3-2.

3.2 Emission Calculations:

a. Hush House or Trim Pad: The primary method for calculating emissions from on wing engine testing involves the use of average fuel flow rates, testing times, and engine specific emission factors. The first step is to determine (for each engine model) the average fuel flowrate for each engine power setting tested. The fuel flowrate will allow for the selection of the most accurate set of emission factors for that engine power setting. It's important to note that all emission factors are based on fuel flowrate, not power setting name. When selecting the emission factors for an engine power setting, select the set that has the nearest fuel flowrate. After selecting the applicable set of emission factors for each power setting, you will need to

determine the total amount of fuel burned (in thousands of pounds) at each of the power settings. The amount of fuel burned at a particular power setting is typically derived by multiplying the average fuel rate at that power setting by the amount of time the engine is tested at the power setting. Emissions can then be calculated by multiplying the total fuel burned times the emission factors which are in units of pounds pollutant emitted per thousand pounds of fuel burned. The following equation is used:

$$E_{pol,\ setting} = [(FFR * t) / 1000] * EF$$

Where,

$E_{pol,\ setting}$ = Emissions of a particular pollutant resulting from testing an aircraft engine at a specific power setting (lb/yr)

FFR = Average fuel flow rate at the applicable power setting (lb/hr) [Note - gallons of fuel can be converted to pounds of fuel by multiplying the gallons times the fuel density (e.g., density of JP-8 is 6.8 lb/gal)]

t = Total annual time in which the engine was tested while operating at the specific power setting (hr/yr) [Note - if the amount of time spent to test an engine at a particular power setting is about the same for each test, then the total annual testing time can be estimated by multiplying the number of tests performed during the year times the average time per test]

1000 = Factor for converting "lb fuel" to "1000 lb fuel"

EF = Emission factor in pounds pollutant per thousand pounds of fuel burned (lb/1000 lb)

After the emissions of a particular pollutant are calculated for each applicable power setting, the values are added together to obtain the total annual emissions for that pollutant.

Aircraft engine and APU emission factors can be found in Tables 3-3 through 3-5. However, one pollutant that is not found in these tables (i.e., was not measured during aircraft sampling) is SO_X. Instead, SO_X emission factors are derived by assuming all the sulfur in the fuel is converted to SO_X (as SO_2) during combustion. Based on this assumption, SO_X emission factors are calculated using the following equation:

$$EF_{SOx} = 20 * S$$

Where,

EF_{SOx} = SO_X emission factor [pounds SO_X emitted per thousand pounds of fuel combusted (lb/1000 lb)]

20 = Factor which is derived by converting "weight percent" into units of "lb/1000 lb" and then multiplying times the ratio of the molecular weight of SO_2 to the molecular weight of sulfur

S = Weight percent sulfur content of the fuel

The weight percent sulfur content of the fuel (S) usually varies depending on the supplier and the geographical location where the fuel is produced. Therefore, a typical sulfur content value should be obtained from the fuel supplier whenever possible. If this information is not available, then one of the average sulfur content values listed in Table 3-6 can be used.

b. APU: APU emissions are calculated in the same manner as aircraft engine testing emissions, except "engine testing time" is replaced with "APU operating time."

c. LTO: LTO emissions are based on the type of aircraft, aircraft engine model, amount of time spent in each operational mode, the power setting associated with each operational mode, the fuel firing rate at each power setting, the average atmospheric mixing height, and the number of LTO cycles conducted during the year. Each aircraft type may have a unique LTO scenario. The amount of time spent in each operational mode and the fuel firing rates for each power setting will change with different aircraft models.

There are two methods for calculating LTO emissions. Both methods use the same emission calculation formulas. The first, and most accurate, method uses actual operational and base specific data. Using this method will require (for each aircraft type) determining the average time the aircraft spends in each LTO cycle mode, the average fuel flowrate (based on power setting) used during each LTO cycle mode, and the base specific average atmospheric mixing zone height. The second method involves the use of default data. This includes using the EPA default time-in-mode values listed in Table 3-7, using the fuel flowrates listed in Table 3-3, and using an average atmospheric mixing zone height of 3000 feet. When obtaining emission factors, and fuel flow rates if necessary, from Table 3-3, the following LTO Cycle Mode / Power Setting correlations are typically used:

LTO Cycle Mode	Power Setting Emission Factors
Approach	Approach
Taxi/Idle-in	Idle
Taxi/Idle-out	Idle
Takeoff	Military or Afterburner
Climbout	Intermediate

Emissions from LTO operations associated with a particular aircraft can be calculated using a three-step approach. The first step involves calculating pollutant emissions for each applicable LTO mode (i.e., approach, taxi/idle-in, taxi/idle-out, takeoff, and climbout) during a single LTO cycle. The second step is to add together the emissions from each LTO mode to get the total emissions for a single LTO cycle. The final step is to multiply the pollutant emissions associated with a single LTO cycle times the number of LTO cycles conducted in a year to obtain the annual LTO emissions. The following equations are used:

Step 1 – Calculate pollutant emissions by mode for a single LTO cycle

$$EPC_{pol,\,mode} = (TIM / 60) * (FFR / 1000) * EF * NE$$

Where,

$EPC_{pol, mode}$ = Emissions per cycle for a particular pollutant during a particular mode (lb/cycle)
TIM = Time in Mode (min/cycle)
60 = Factor for converting minutes into hours (min/hr)
FFR = Fuel Flow Rate per engine (lb/hr)
1000 = Factor for converting "lb/hr" to "1000 lb/hr"
EF = Emission Factor (lb/1000 lb)
NE = Number of engines on the aircraft

Step 2 – Calculate the total pollutant emissions for a single LTO cycle

$$EPC_{pol, total} = EPC_{pol, approach} + EPC_{pol, taxi/idle\text{-}in} + EPC_{pol, taxi/idle\text{-}out} + EPC_{pol, takeoff} + EPC_{pol, climbout}$$

Where,

$EPC_{pol, total}$ = Total emissions per cycle for a particular pollutant (lb/cycle)
$EPC_{pol, approach}$ = Emissions per cycle for a particular pollutant during the "approach" mode (lb/cycle)
$EPC_{pol, taxi/idle\text{-}in}$ = Emissions per cycle for a particular pollutant during the "taxi/idle-in" mode (lb/cycle)
$EPC_{pol, taxi/idle\text{-}out}$ = Emissions per cycle for a particular pollutant during the "taxi/idle-out" mode (lb/cycle)
$EPC_{pol, takeoff}$ = Emissions per cycle for a particular pollutant during the "takeoff" mode (lb/cycle)
$EPC_{pol, climbout}$ = Emissions per cycle for a particular pollutant during the "climbout" mode (lb/cycle)

Step 3 – Calculate the pollutant emissions from the annual LTO operations associated with a particular aircraft

$$E_{pol} = EPC_{pol, total} * NC_{LTO}$$

Where,

E_{pol} = Emissions of a particular pollutant resulting from the annual LTO operations associated with a particular aircraft (lb/yr)
NC_{LTO} = Number of LTO cycles conducted during the year by the specific aircraft that emissions are being calculated for (cycles/yr)

d. TGO and LFB: TGO and LFB emissions are calculated in the same manner as LTO emissions except the "taxi/idle-in" and "taxi/idle-out" modes are not included.

e. LFP (within base air space): Emissions from LFP flights occurring within base air space are calculated based on the type of aircraft, aircraft engine model, average time that the aircraft is

performing a LFP flight within base air space (i.e., flying over base property at an altitude that is below the average mixing zone height), the number of LFP flights conducted during the year, the typical power setting the aircraft's engine(s) operate at during the LFP, and the fuel firing rate at the applicable power setting. The following equation is used:

$$E_{pol} = (AT / 60) * NF * (FFR / 1000) * EF * NE$$

Where,

E_{pol} = Emissions of a particular pollutant generated from a specific aircraft's annual LFP flights within base air space (lb/yr)
AT = Average time per LFP flight (by the applicable aircraft) within base air space (min/flight)
60 = Factor for converting minutes into hours (min/hour)
NF = Number of LFP flights (within base air space) conducted by the applicable aircraft during the year (flights/yr)
FFR = Fuel Flow Rate per engine (lb/hr)
1000 = Factor for converting "lb/hr" to "1000 lb/hr"
EF = Emission Factor (lb/1000 lb)
NE = Number of engines on the aircraft

Note – if the aircraft uses more than one power setting (and subsequently, fuel flow rate) during its LFP flights, then the above calculations should be re-accomplished for each different power setting used.

f. LFP (outside base air space): Emissions from LFP flights occurring outside base air space are calculated in the same manner as emissions from LFP flights occurring within base air space, except the average LFP flight time is that which occurs in the airspace adjacent to the base instead of over the base.

3.3 Information Resources: The Aircraft Maintenance organization should be contacted to obtain the information needed to calculate emissions from on wing aircraft engine testing operations, including the types of engines tested, the number of tests conducted during the year on each engine type, the average time spent at each power setting during a typical engine test, and the typical fuel flow rate used during testing at each power setting. An example of a data collection form for collecting data on aircraft engine testing is provided in Figure 3-1.

The Flightline Operations Group and aircraft pilots should be contacted to obtain information required to calculate emissions from aircraft flying operations (i.e., LTOs, TGOs, LFBs, and LFPs). An example of a data collection form for collecting data on the number of aircraft flying operations is provided in Figure 3-2. An example of a survey questionnaire for collecting data on a base's specific aircraft flightline operations is provided in Appendix D.

If applicable, the Civil Air Patrol and/or the Aero Club should be contacted to obtain information on their small aircraft.

Finally, the Weather Detachment should be contacted to obtain the average atmospheric mixing zone height for the base. An example of a data collection form which can be used to obtain the average atmospheric mixing zone height is provided in Figure 3-3.

3.4 Example Calculations:

a. Problem 1 – On Wing Engine Testing

An Air Force installation uses a hush house to perform on wing evaluations on the F110-GE-100 engine which is used on their F-16D aircraft. The base is located in Southeastern part of the U.S. and uses JP-8 fuel that is produced (refined) in Louisiana. According to records kept by the Aircraft Maintenance organization, 102 on wing engine tests were performed during the year. Each test involved the following power settings: Idle, Approach, Intermediate, Military, and Afterburner. The operating times and fuel flow rates for each power setting were approximately the same for each test, and are as follows:

Power Setting	Average Fuel Flow Rate During Testing (lb/hr)	Average Operating Time per Test (minutes)
Idle	1,100	20
Approach	4,250	45
Intermediate	6,500	15
Military	10,100	15
Afterburner	16,200	5

Calculate the CO and SO_X emissions associated with the testing of the F110-GE-100 engine.

The first step is to calculate the total time (hours) during the year in which testing was performed at each power setting.

Total Time in Idle: 102 test/yr * 20 min/test * (1 hr/60 min) = 34 hr/yr
Total Time in Approach: 102 test/yr * 45 min/test * (1 hr/60 min) = 76.5 hr/yr
Total Time in Intermediate: 102 test/yr * 15 min/test * (1 hr/60 min) = 25.5 hr/yr
Total Time in Military: 102 test/yr * 15 min/test * (1 hr/60 min) = 25.5 hr/yr
Total Time in Afterburner: 102 test/yr * 5 min/test * (1 hr/60 min) = 8.5 hr/yr

The second step is to calculate the carbon monoxide emissions from testing at each power setting and then summing these values to get the Total CO emissions.

Power Setting	Fuel Flow Rate (lb/hr)		Total Time Tested (hr/yr)		lb to 1000 lb Conversion		CO Emission Factor (lb/1000 lb)		CO Emissions (lb/yr)
Idle	1,100	x	34	/	1000	x	24.08	=	901
Approach	4,250	x	76.5	/	1000	x	4	=	1,301
Intermediate	6,500	x	25.5	/	1000	x	2.2	=	365
Military	10,100	x	25.5	/	1000	x	2.05	=	528
Afterburner	16,200	x	8.5	/	1000	x	97.5	=	13,426
						Total CO Emissions		**=**	**16,521**

The next step is to calculate the SO_X emission factor based on the sulfur content of the jet fuel (obtained from Table 3-6).

$EF_{SOx} = 20 * S$
$EF_{SOx} = 20 * 0.042 = 0.84$ lb/1000 lb

The final step is to calculate the SO_X emissions.

Power Setting	Fuel Flow Rate (lb/hr)		Total Time Tested (hr/yr)		lb to 1000 lb Conversion		SO_X Emission Factor (lb/1000 lb)		SO_X Emissions (lb/yr)
Idle	1,100	x	34	/	1000	x	0.84	=	31
Approach	4,250	x	76.5	/	1000	x	0.84	=	273
Intermediate	6,500	x	25.5	/	1000	x	0.84	=	139
Military	10,100	x	25.5	/	1000	x	0.84	=	216
Afterburner	16,200	x	8.5	/	1000	x	0.84	=	116
						Total SO_x Emissions		=	**775**

b. Problem 2 - LTOs

Base X needs to calculate the annual CO emissions from LTO operations involving their F-15 aircraft. The following information was obtained from the base:

Aircraft Model: F-15D
Engine Model: F100-PW-220
Number of Engines: 2
Number of LTO cycles conducted during the year: 6,875
Mode Specific Information:

Mode	Average Time in Mode (min/cycle)	Typical Power Setting	Average Fuel Flow Rate (lb/hr)
Approach	3	Approach	3,650
Taxi/Idle-in	10	Idle	1,100
Taxi/Idle-out	30	Idle	1,100
Takeoff	1	Military	9,725
Climbout	0.5	Intermediate	5,800

Based on the above information, calculate the annual CO emissions from F-15D LTO operations at Base X.

The first step is to calculate the CO emissions for each applicable mode during a single LTO cycle:

$EPC_{pol, mode} = (TIM / 60) * (FFR / 1000) * EF * NE$
$EPC_{CO, approach} = (3 \text{ min/cycle} / 60 \text{ min/hr}) * (3,650 \text{ lb/hr} / 1000) * 1.92 \text{ lb/1000 lb} * 2$
$= 0.70$ lb/cycle

$EPC_{CO,\ taxi/idle\text{-}in}$ = (10 min/cycle / 60 min/hr) * (1,100 lb/hr / 1000) * 35.3 lb/1000 lb * 2
= 12.94 lb/cycle

$EPC_{CO,\ taxi/idle\text{-}out}$ = (30 min/cycle / 60 min/hr) * (1,100 lb/hr / 1000) * 35.3 lb/1000 lb * 2
= 38.83 lb/cycle

$EPC_{CO,\ takeoff}$ = (1 min/cycle / 60 min/hr) * (9,725 lb/hr / 1000) * 0.86 lb/1000 lb * 2
= 0.28 lb/cycle

$EPC_{CO,\ climbout}$ = (0.5 min/cycle / 60 min/hr) * (5,800 lb/hr / 1000) * 0.86 lb/1000 lb * 2
= 0.08 lb/cycle

The second step is to calculate the total CO emissions for a single LTO cycle:

$EPC_{pol,\ total} = EPC_{pol,\ approach} + EPC_{pol,\ taxi/idle\text{-}in} + EPC_{pol,\ taxi/idle\text{-}out} + EPC_{pol,\ takeoff} + EPC_{pol,\ climbout}$

$EPC_{CO,\ total}$ = 0.70 lb/cycle + 12.94 lb/cycle + 38.83 lb/cycle + 0.28 lb/cycle + 0.08 lb/cycle
= 52.83 lb/cycle

The final step is to calculate the annual CO emissions:

$E_{pol} = EPC_{pol,\ total} * NC_{LTO}$

E_{pol} = 52.83 lb/cycle * 6,875 cycles/yr = **363,206 lb/yr**

Table 3-1. U.S. Air Force Aircraft Engines

Aircraft Model	Engine Model
A-10A/B	TF34-GE-100/-100A
B-1B	F101-GE-102
B-2	F118-GE-100
B-52H	TF33-P-3/103
C-5A/B	TF39-GE-1A/-1C
KC-10A	F103-GE-101
C-12A	PT6A-38
C-12D	PT6A-41
C-12E/F/J	PT6A-42
C-17A	F117-PW-100
CEC-18A/B	TF33-PW-102A
C-20A	F113-RR-100
C-21A	TFE731-2/-2A
CV-22	T406-AD-400
VC-25A	F103-GE-102
C/NC/RC-130A	T56-A-9
AC-130A	T56-A-9
DC-130A	T56-A-9
C-130D	T56-A-9
C/HC/NC-130B	T56-A-7B
MC-130E	T56-A-7B
WC-130F	T56-A-7B
C/AC/DC/EC/HC/C/MC/NC/WC-130H	T56-A-15
HC-130N	T56-A-15
HC-130P	T56-A-15
AC/130U	T56-A-15
C-130J	AE2100D3
C/EC/WC-135B	TF33-P-5
C-135C	TF33-P-5
RC-135N	TF33-P-5
EC-135N	TF33-P-5
EC-135P	TF33-P-5
RC/TC-135S	TF33-P-5
RC-135V	TF33-P-5
RC-135X	TF33-P-5
RC/TC-135W	TF33-P-5
EC-135C	TF33-P-9
EC135J	TF33-P-9
RC-135U	TF33-P-9
C/EC/RC-135E	TF33-P-102
KC/NKC-135E	TF33-P-102

Table 3-1. U.S. Air Force Aircraft Engines (Cont'd)

Aircraft Model	Engine Model
KC-135-R	F108-CF-100
VC-137B/C	JT3D-3B
C/NC-141A/B	TF33-P-/7-7A
E-3B/C	TF33-PW-100A
E-4B	F103-GE-100
EF-111A	TF30-P-109
F-111D	TF30-P-109
F-15A/B/C/D	F100-PW-100
F-15C/D/E	F100-PW-220
F-15E	F100-PW-229
F-16A/B	F100-PW-200
F-16C/D	F100-PW-100
F-16C/D	F110-GE-100, F110-GE-129
F-16C/D	F100-PW-229
F-22A	F119-PW-100
F117A	F404-GE-F1D2
T-1A	JT15D-5B
T-6A	PT6A-68
T-37B	J69-T-25/-25A
AT/T-38A/B	J85-GE-5/-5B/-5F/-5G/-5H/-5J/-5L
U-2S	F118-GE-101
HH-1H	T53-L-13B
HH-3E	T58-GE-5
CH-3E	T58-GE-5
MH-53J	T64-GE-100
NCH-53A	T64-GE-100
TH-53A	T64-GE-100
UH-1N	T400-CP-400
UH-60A	T700-GE-700

Table 3-2. U.S. Air Force Auxiliary Power Units

Aircraft Model	APU Model
B-1B	GTCP165-9/1
C5 A/B	GTCP165-1B/2
C-130H	GTCP85-180L/1
UH/MH/HH-53	T62T27/1

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
F100-PW-100	Idle	1,097	4.38	35.29	8.60	2.06
	Approach	2,746	12.33	3.49	0.16	2.63
	Intermediate	7,617	30.89	0.91	0.14	2.06
	Military	10,104	39.44	0.90	0.28	1.33
	AB-5	54,074	6.62	9.57	0.05	1.15
	Notes: 1, 2A, 3, 5, 11A, 19A & B					
F100-PW-200	Idle	1,016	4.99	26.61	8.28	2.06
	Approach	3,135	13.82	1.38	0.26	2.63
	Intermediate	5,406	27.60	0.49	0.22	2.06
	Military	8,717	39.12	0.86	0.13	1.33
	AB-5	40,247	7.03	9.47	0.14	1.15
	Notes: 1, 2A, 4, 6, 11A, 19A & B					
F100-PW-220	Idle	1,084	4.61	35.30	7.94	2.06
	Approach	3,837	12.53	1.92	5.12	2.63
	Intermediate	5,770	22.18	0.86	2.89	2.06
	Military	9,679	29.32	0.86	1.79	1.33
	AB-5	41,682	8.37	11.99	1.53	1.15
	Notes: 1, 2A, 7, 11A, 19A & B					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
F100-PW-229	Idle	1,087	3.80	10.16	0.38	2.06
	Approach	3,098	15.08	1.17	0.21	2.63
	Intermediate	5,838	17.53	0.15	0.30	2.06
	Military	11,490	57.65	0.66	0.54	1.33
	AB-1	20,793	50.92	76.62	16.26	1.15
	Notes: 1, 2A, 3, 11B, 19A & C					
F101-GE-102	Idle	1,117	4.10	24.47	0.00	2.17
	Approach	4,533	9.16	1.03	0.14	4.23
	Intermediate	6,557	13.15	0.85	0.13	1.35
	Military	7,828	12.83	0.83	0.11	1.68
	AB-1	15,314	16.91	43.47	61.82	2.86
	Notes: 1, 2A, 3, 11B, 19B					
F103-GE-100 & 101	Idle	1,706	3.60	61.79	21.80	2.75
	Approach	5,238	9.50	4.30	1.00	1.19
	Intermediate	15,675	29.79	0.50	0.70	0.89
	Military	19,738	36.54	0.50	0.60	1.18
	Notes: 1, 2B, 9, 11D, 19C, TF39 Data for Particulate Emissions					
F108-CF-100	Idle	1,136	3.94	27.19	0.92	9.08
	Approach	2,547	6.96	6.39	0.04	1.55
	Intermediate	5,650	13.53	1.61	0.03	0.65
	Military	6,458	15.28	0.63	0.03	1.59
	Notes: 1, 2A, 3, 11B, 19B					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
F110-GE-100	Idle	1,044	5.19	24.08	1.02	1.84
	Approach	4,128	10.87	4.00	0.36	0.95
	Intermediate	6,598	18.25	2.20	0.19	0.57
	Military	9,974	30.35	2.05	0.62	0.14
	AB-1	16,374	15.55	97.50	69.33	3.34
	Notes: 1, 2A, 3, 11B, 16, 19A					
F110-GE-129	Idle	1,036	3.19	34.58	2.64	2.61
	Approach	4,956	11.60	3.85	0.05	1.37
	Intermediate	7,136	17.33	2.49	0.01	0.57
	Military	9,985	27.13	2.42	0.54	0.14
	AB-1	16,826	15.08	104.60	64.80	3.34
	Notes: 1, 2A, 3, 11A, 19B					
F113-RR-100	Idle	1,088	3.59	31.70	3.68	No Data
	Approach	2,206	7.15	2.63	0.18	No Data
	Climb Out	5,762	17.14	0.63	0.12	No Data
	Take-off	7,072	22.63	11.96	0.09	No Data
	Notes: 1, 2B, 9, 11D, 19C					
F117-PW-100	Idle	1,104	3.96	23.86	2.15	10.54
	Approach	4,279	13.03	1.25	0.30	5.52
	Climb Out	10,919	30.02	0.36	0.21	2.31
	Take-off	13,976	34.30	0.40	0.03	2.31
	Notes: 1, 2A, 2B, 3, 11A, 13, 19C					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
F118-GE-100	Idle	1,097	4.30	20.98	0.59	1.25
	Approach	3,773	11.09	2.02	0.87	4.47
	Intermediate	6,350	18.01	0.84	ND	1.78
	Military	10,887	33.12	0.65	ND	1.64
	Notes: 1, 2B, 3, 11A, 19B					
F404-GE-400/FID2	Idle	654	1.43	123.75	54.82	4.48
	Approach	3,110	7.14	3.17	0.85	1.46
	Intermediate	6,503	15.92	1.32	0.27	1.57
	Military	7,617	22.27	1.33	0.24	1.61
	Notes: 1, 2A, 3, 8, 11A, 19B					
J69-25A	Idle	167	0.80	159.84	15.00	3.16
	Intermediate	872	2.92	38.25	0.07	0.93
	Military	1,085	4.52	32.85	0.20	0.66
	Notes: 1, 2A, 3, 11A, 19C					
J85-GE-5H	Idle	506	2.11	158.22	15.34	4.70
	Approach	1,071	2.86	93.67	3.04	1.79
	Intermediate	2,155	5.67	28.38	0.64	1.13
	Military	2,815	4.66	28.98	0.52	1.13
	AB	8,138	2.09	14.19	2.29	0.25
	Notes: 1, 2A, 3, 8, 11A, 11B, 19A					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
JT3D-3B	Idle	1,068	1.80	117.03	106.96	4.98
	Approach	3,613	5.84	12.37	1.75	3.55
	Intermediate	8,574	8.74	2.01	0.95	3.15
	Military	9,790	12.39	0.45	0.53	3.67
	Notes: 1, 2A, 2C, 3, 9, 11B, 19B					
JT15D-5B	Idle	221	2.15	108.14	79.60	4.98
	Approach	496	5.11	35.30	8.43	3.55
	Climb Out	1,359	9.67	1.63	0.70	3.15
	Take-off	1,630	11.30	0.20	0.10	2.52
	Notes: 1, 2B, 11E, 14, 19B					
PT6A-27	Idle	115	2.43	64.00	50.14	No Data
	Approach	215	8.37	23.30	2.19	No Data
	Climb Out	400	7.00	1.20	0.00	No Data
	Take-Off	425	7.83	1.00	0.00	No Data
	Notes: 1, 2B, 9, 11D, 19C					
PT6A-41&42	Idle	147	1.96	115.12	101.46	No Data
	Approach	273	4.64	34.77	22.69	No Data
	Climb Out	473	7.55	6.48	2.02	No Data
	Take-Off	510	7.98	5.1	1.75	No Data
	Notes: 1, 2B, 9, 11D, 19C					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
PT6A-68	Idle	191	2.70	73.40	25.20	No Data
	Approach	334	4.40	23.70	4.20	No Data
	Intermediate	587	6.40	6.90	0.30	No Data
	Military	651	8.80	5.20	0.20	No Data
	Notes: 1, 2B, 10, 11A, 18, 19C					
T56-A-7	Ground Idle	740	5.62	15.09	7.60	3.64
	Flight Idle	924	6.58	5.45	0.73	3.85
	Normal RTD	1,611	10.12	2.44	0.33	1.46
	Int Mil	2,105	11.50	2.46	0.23	1.22
	Notes: 1, 2A, 3, 8, 11B, 19A					
T56-A-9	Ground Idle	725	7.47	5.62	2.25	3.64
	Flight Idle	949	7.35	4.30	0.77	3.85
	Normal RTD	1,724	9.39	2.44	0.51	1.46
	Int Mil	2,068	11.19	2.51	0.35	1.22
	Notes: 1, 2A, 2C, 11B, 17, 19B, T56-A-7 Data					
T56-A-15	Ground Idle	900	7.49	3.84	1.97	3.64
	Flight Idle	1,240	8.31	2.82	0.58	3.85
	Normal RTD	2,180	9.69	1.65	0.42	1.46
	Int Mil	2,456	11.42	1.77	0.28	1.22
	Notes: 1, 2A, 2C, 6, 11B, 17, 19B, T56-A-7 Data					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
T406-AD-400	Idle	362	4.15	8.35	0.1	1.58
	Flight Idle	663	6.05	3.47	0.02	1.58
	Intermediate	948	7.87	1.82	0.02	1.58
	Max Continuous	2,507	18.03	0.29	0.01	1.58
	Notes: 1, 2A, 2B, 11B, 19A, 20					
TF30-P-109	Idle	761	2.93	48.85	26.60	1.24
	Approach	2,900	5.80	19.50	5.41	1.34
	Intermediate	5,900	9.59	5.16	0.82	1.65
	Military	6,262	23.70	0.71	0.17	0.92
	AB-5	38,460	4.88	6.19	0.15	0.52
	Notes: 1, 2A, 6, 8, 11A, 12, 19C					
TF33-P-3/103	Idle	900	1.39	95.06	90.91	4.98
	Approach	3,800	6.37	5.24	1.37	3.55
	Intermediate	6,240	7.88	2.11	1.50	3.15
	Military	7,440	12.08	0.00	0.55	3.67
	Notes: 1, 2A, 2C, 11B, 19C, TF33-P-102 Data					
TF33-P-5&9	Idle	1,120	1.39	95.06	90.91	4.98
	Approach	4,140	6.37	5.24	1.37	3.55
	Intermediate	8,960	7.88	2.11	1.50	3.15
	Military	9,630	12.08	0.00	0.55	3.67
	Notes: 1, 2A, 2C, 11B, 19C, TF33-P-102 Data					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
TF33-P-7/7A	Idle	1,055	1.50	136.96	131.16	6.13
	Approach	3,986	6.22	14.60	3.62	5.46
	Intermediate	7,632	8.47	2.96	0.39	5.29
	Military	9,108	11.49	1.19	0.25	2.93
	Notes: 1, 2, 3A, 9, 19B					
TF33-P-100	Idle	1,108	1.50	136.96	131.16	6.13
	Approach	2,794	6.22	14.60	3.62	5.46
	Intermediate	8,069	8.47	2.96	0.39	5.29
	Military	10,856	11.49	1.19	0.25	2.93
	Notes: 1, 2A, 2C, 3, 11B, 19B					
TF33-P-102&102A	Idle	1,065	1.80	117.03	106.96	4.98
	Approach	3,912	5.84	12.37	1.74	3.55
	Intermediate	6,985	8.74	2.01	0.95	3.15
	Military	8,756	12.39	0.45	0.53	3.67
	Notes: 1, 2A, 3, 11B, 19B					
TF34-GE-100-100A	Idle	449	1.35	86.68	20.70	8.00
	Approach	773	4.02	25.65	1.49	6.19
	Intermediate	1,516	6.42	6.28	0.65	8.93
	Military	3,026	8.83	4.00	0.40	2.67
	Notes: 1, 2A, 3, 8, 11A, 19A					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
TF39-GE-1C	Idle	1,448	3.36	58.21	16.43	2.75
	Approach	10,477	24.72	0.77	0.67	1.19
	Intermediate	12,541	28.16	1.63	0.00	0.89
	Military	13,861	32.66	1.28	0.00	1.18
	Notes: 1, 2A, 3, 11B, 19C					
TFE731-2/2A	Idle	206	3.50	47.80	8.54	No Data
	Approach	571	6.90	15.56	1.41	No Data
	Climb Out	1,476	16.08	1.62	0.07	No Data
	Take-Off	1,786	19.15	1.13	0.06	No Data
	Notes: 1, 2B, 11D, 19B					
T53-L-13	Ground Idle	145	1.58	31.51	67.41	No Data
	Flight Idle	222	2.53	37.79	15.75	No Data
	Normal Rated	645	6.43	6.83	0.66	No Data
	Military	685	6.34	3.34	0.30	No Data
	Take-Off	690	7.75	3.85	0.32	No Data
	Notes: 1, 2B, 8, 11B, 19C					
T58-GE-5	Idle	133	1.24	174.62	86.24	1.48
	75%	623	5.74	13.88	1.13	2.22
	Normal Cruise	757	6.41	10.13	1.40	2.60
	Int Mil	821	6.77	9.34	2.93	2.60
	PR Take-Off	886	7.32	8.13	0.74	2.60
	Notes: 1, 2B, 8, 11B, 19C					

Table 3-3. Criteria Pollutant Emission Factors for Aircraft Engines (Cont'd)

Aircraft Engine	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
T64-GE-100	Idle	284	1.62	75.46	27.97	2.36
	75% Normal	1,217	5.49	4.97	0.20	1.97
	Normal	1,714	7.45	1.85	0.06	1.61
	Military	1,882	8.01	2.97	0.29	0.92
	Notes: 1, 2B, 3, 11B, 19B					
T400-CP-400	Ground Idle	138	3.05	29.78	10.42	No Data
	Flight Idle	143	3.08	30.71	8.65	No Data
	Cruise	283	4.90	2.64	0.18	No Data
	Military	412	6.68	0.75	0.13	No Data
	Notes: 1, 2B, 8, 11B, 19C					
T700-GE-700	Ground Idle	133	2.78	53.18	56.67	1.48
	Flight Idle	500	7.56	5.25	0.37	1.26
	Flight Max	589	8.18	3.75	0.49	2.22
	Overspeed	706	8.61	3.09	0.39	2.60
	Notes: 1, 2A, 3, 11A, 19A					

[a] VOC emission factors are based on values for total hydrocarbons.

[b] Includes both filterable and condensable PM_{10}. AFIERA/RSEA should be contacted if emission factors specifically for "Filterable PM_{10}" are required.

Table 3-4. Criteria Pollutant Emission Factors for Auxiliary Power Units

APU	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in lb pollutant per 1000 lb fuel burned (lb/1000 lb)			
			NO_X	CO	VOC [a]	PM_{10} [b]
GTCP165-1	Constant	273	4.52	13.93	0.24	0.48
	Notes: 1, 2A, 3, 11B,19C					
GTCP85-180	No Load	129	4.17	22.00	2.03	0.49
	Constant	270	4.73	7.75	0.02	0.45
	Notes: 1, 2A, 3, 11B, 19B					
T62T27	Idle	50	5.31	29.53	3.43	No Data
	100%	102	3.94	42.77	9.04	No Data
	Notes: 1, 2B, 11D, 19C					

[a] VOC emission factors are based on values for total hydrocarbons.

[b] Includes both filterable and condensable PM_{10}. AFIERA/RSEA should be contacted if emission factors specifically for "Filterable PM_{10}" are required.

NOTES FOR TABLES 3-3 AND 3-4

1. When calculating emissions for a specific engine, always use the emission factor that has the closest fuel flow rate.

2. Emissions data was collected using one of the following methodologies:
   A. EPA Testing Methodologies
   B. ICAO Testing Methodologies
   C. Engine emissions were extrapolated from other engine emission factors.

3. U.S. Air Force AFIERA/RSEQ, Environmental Quality Management Inc, and Roy F. Weston Inc., *Aircraft Engine and Auxiliary Power Unit Emissions Testing*, December 1998.

4. Radian Corporation, *Engine and Hush House Emissions From a F100-PW-200 Jet Engine Tested at Kelly Air Force Base, TX – Final Report – Volume I - III*, February 1997.

5. Radian Corporation, *Engine and Hush House Emissions From a F100-PW-100 Jet Engine Tested at Langley Air Force Base, VA – Volume I - III*, November 1996.

6. Radian Corporation, *Engine and Hush House Emissions From a TF30-P109 Jet Engine Tested at Cannon Air Force Base, NM – Final Report – Volume I - III*, June 1996.

7. Environmental Quality Management Inc., Technical Report for Delivery Order 0001, *Source Sampling of Aerospace Ground Equipment and Jet Engines, Edwards AFB, CA*, August 1996.

8. Naval Aircraft Environmental/Support Office, *Emissions from Aircraft Engines*, 1991.

9. Emissions data was obtained from the Federal Aviation Administration (FAA) database.

10. Emissions data was obtained from the engine manufacturer.

11. Fuel used during the emissions test;
    A. JP-8
    B. JP-5
    C. JP-4
    D. Unknown, but probably Jet A
    E. Jet A-1
    F. Jet A

12. General Electric, T700 Engine Exhaust Mass Emissions, 1976.

13. Manufacturer's Data from Pratt & Whitney, F117-PW-100 Pratt & Whitney Emissions Data, August 1983.

14. Manufacturer's Data from Pratt & Whitney, JT15D-5B Pratt & Whitney Emissions Data, April 1993.

15. Aircraft Environmental Support Office, Table T400.1 *Gaseous Emissions from A T400-CP-400 Engine*, 1987.

16. Battelle Memorial Institute, AD A242 883 *Characterization of Chemicals on Engine Exhaust Particles: F101 and F110 Engines*, August 1989.

17. Emissions test data from Allison Aircraft Engines

18. Emissions test data from Pratt & Whitney, Canada.

19. Emission factors based on:
    A. Three or more emissions tests
    B. Two emissions tests
    C. One emissions test

20. Department of the Navy, Aircraft Environmental Support Office, *Emission Indexes from T406-AD-400 and T58-GE-16 Engines Using JP-5 Fuel*, Report No. 2001-3, January 2001.

Table 3-5. Hazardous Air Pollutant Emission Factors for Aircraft Engines and Auxiliary Power Units

Engine Model Number	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in pounds pollutant per 1000 pounds fuel burned (lb/1000 lb)									
			Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methyl Ethyl Ketone	Naphthalene	Styrene	Toluene	Xylenes
F100 Series	Idle	1,097	2.0E-01	9.7E-02	9.8E-02	4.8E-03	8.2E-01	2.0E-02	6.4E-02	4.8E-03	2.0E-02	3.6E-02
	Approach	2,746	1.5E-01	6.0E-02	3.5E-03	1.4E-03	6.1E-01	2.0E-02	4.8E-04	No Data	2.7E-03	1.0E-02
	Inter	7,617	8.0E-03	No Data	2.0E-03	2.7E-04	2.0E-02	3.0E-03	4.4E-03	2.8E-04	3.5E-03	8.0E-03
	Mil	10,104	1.1E-02	No Data	3.0E-03	2.4E-03	6.0E-03	3.0E-03	3.7E-04	No Data	5.0E-03	2.6E-02
	AB-5	54,074	1.3E-02	No Data	7.7E-03	2.2E-03	1.5E-02	4.0E-03	4.8E-04	No Data	1.2E-02	2.5E-02
T56-A-7	Ground Idle	724	1.0E-02	No Data	4.8E-03	No Data	4.1E-02	1.3E-04	1.2E-03	No Data	2.7E-03	3.1E-04
	Flight Idle	880	0.0E+00	No Data	4.5E-03	6.2E-04	3.3E-02	7.0E-05	1.0E-03	3.7E-04	2.3E-03	1.1E-03
	Norm.RTD	1,742	5.4E-04	No Data	1.3E-03	3.1E-04	9.3E-03	No Data	1.8E-04	No Data	9.6E-04	5.8E-04
	Int Mil	2,262	1.6E-04	No Data	7.9E-04	1.8E-04	3.8E-04	6.2E-05	1.3E-04	No Data	2.5E-05	8.8E-04
TF39-GE-1C	Idle	1,448	2.1E-01	2.1E-01	3.6E-01	2.0E-02	1.4E+00	3.7E-02	9.7E-02	4.5E-02	1.3E-01	5.8E-02
	Approach	10,477	3.2E-03	No Data	1.6E-03	1.8E-03	8.2E-03	No Data	0.0E+00	No Data	0.0E+00	1.6E-03
	Inter	12,541	2.6E-04	No Data	1.4E-03	5.0E-04	4.9E-03	2.4E-04	0.0E+00	No Data	0.0E+00	2.6E-03
	Mil	13,862	6.2E-04	No Data	2.2E-03	0.0E+00	1.1E-02	2.5E-04	0.0E+00	9.3E-04	0.0E+00	0.0E+00
FTCP85-180	Constant	270	2.1E-03	3.0E-04	1.5E-02	1.2E-04	2.0E-02	No Data	0.0E+00	1.9E-04	4.4E-03	2.7E-03
GTCP165-1	Constant	273	5.6E-03	No Data	3.9E-02	8.8E-04	1.9E-02	1.8E-03	5.6E-03	2.3E-03	1.9E-02	6.1E-03
J69-T25A	Idle	167	9.8E-02	2.0E-01	1.9E-01	2.0E-02	9.1E-01	3.7E-02	3.5E-02	2.7E-02	1.1E-01	8.9E-02
	Inter	872	2.1E-03	No Data	3.5E-03	No Data	2.7E-02	No Data	3.4E-04	No Data	1.6E-03	1.9E-03
	Mil	1,085	No Data	No Data	1.9E-03	No Data	1.2E-02	No Data	2.2E-04	No Data	8.3E-04	5.8E-04

Table 3-5. Hazardous Air Pollutant Emission Factors for Aircraft Engines and Auxiliary Power Units (Cont'd)

Engine Model Number	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in pounds pollutant per 1000 pounds fuel burned (lb/1000 lb)									
			Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methyl Ethyl Ketone	Naphthalene	Styrene	Toluene	Xylenes
J85-GE-5H	Idle	434	1.0E-01	2.3E-01	1.3E-01	2.6E-02	1.9E-01	No Data	8.2E-02	3.5E-02	1.4E-01	1.2E-01
	Inter	950	No Data	No Data	1.6E-01	1.1E-02	6.5E-01	No Data	1.5E-02	1.5E-02	5.8E-02	4.3E-02
	Mil	2,740	No Data	No Data	1.3E-02	4.1E-04	8.2E-02	No Data	1.4E-03	5.6E-04	3.6E-03	1.6E-02
	Aftburn	8,138	No Data	No Data	7.2E-03	5.5E-04	2.5E-02	No Data	8.6E-04	3.0E-04	1.8E-03	2.9E-03
T700-GE-700	G Idle	134	1.8E-02	7.2E-03	4.9E-02	2.3E-03	2.2E-01	No Data	7.3E-03	5.2E-03	1.3E-02	7.2E-03
	F Idle	469	3.0E-04	9.7E-05	3.0E-04	4.7E-04	4.1E-03	No Data	1.6E-04	No Data	3.4E-04	6.8E-04
	F Max	626	No Data	No Data	3.1E-04	No Data	No Data	No Data	6.7E-05	No Data	0.0E+00	5.1E-04
	Over	725	No Data	No Data	3.0E-04	2.0E-04	4.8E-04	No Data	2.9E-05	No Data	2.9E-04	1.2E-03
F108-CF-100	Idle	1,136	0.0E+00	No Data	1.4E-02	1.0E-03	9.5E-02	5.5E-03	2.9E-03	1.5E-03	9.0E-03	1.7E-03
	Approach	2,547	No Data	No Data	3.4E-03	8.1E-04	1.5E-02	No Data	0.0E+00	No Data	6.2E-03	2.1E-03
	Inter	5,650	No Data	No Data	8.3E-04	No Data	5.6E-03	No Data	No Data	No Data	1.4E-03	6.3E-04
	Mil	6,458	No Data	No Data	5.9E-04	No Data	7.0E-03	No Data	No Data	No Data	1.1E-03	5.0E-04
TF33-P-7/7A	Idle	1,093	No Data	No Data	5.2E-01	2.0E-01	2.3E+00	No Data	3.7E-01	2.4E-01	3.7E-01	4.6E-01
	Approach	4,844	8.7E-03	No Data	2.9E-02	2.1E-03	1.3E-01	No Data	3.1E-03	3.5E-03	1.0E-02	4.9E-03
	Inter	6,356	No Data	No Data	6.5E-03	5.1E-04	2.8E-02	No Data	3.6E-04	7.5E-04	2.5E-03	1.5E-03
	Mil	8,264	No Data	No Data	1.5E-03	4.4E-04	5.3E-03	No Data	0.0E+00	No Data	2.3E-03	1.7E-03
F101-GE-102	Idle	1,117	No Data	No Data	1.2E-02	No Data	1.0E-01	No Data	1.8E-03	1.1E-03	5.6E-03	9.2E-04
	Approach	4,533	No Data	No Data	7.9E-04	No Data	5.1E-03	No Data	0.0E+00	No Data	1.5E-03	5.9E-04
	Inter	6,557	No Data	No Data	1.3E-03	No Data	4.6E-03	No Data	No Data	5.5E-03	1.7E-03	7.3E-04
	Mil	7,828	No Data	No Data	5.5E-03	No Data	4.4E-03	No Data	No Data	No Data	1.9E-03	2.5E-03
	Aftburn	15,314	1.8E-02	8.2E-02	2.3E-01	8.6E-02	3.9E-02	1.5E-02	1.3E-01	1.2E-02	1.3E-01	2.2E-01

Table 3-5. Hazardous Air Pollutant Emission Factors for Aircraft Engines and Auxiliary Power Units (Cont'd)

Engine Model Number	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in pounds pollutant per 1000 pounds fuel burned (lb/1000 lb)									
			Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methyl Ethyl Ketone	Naphthalene	Styrene	Toluene	Xylenes
TF33-P-102	Idle	1,114	1.0E-02	No Data	7.1E-01	8.7E-02	9.4E-01	No Data	2.1E-01	1.1E-01	2.7E-01	2.0E-01
	Approach	4,737	0.0E+00	No Data	1.1E-02	8.2E-04	6.6E-01	No Data	1.1E-03	1.2E-03	2.3E-03	2.4E-03
	Inter	5,782	No Data	No Data	4.1E-03	6.2E-04	2.3E-02	No Data	7.4E-04	5.8E-04	2.7E-03	1.4E-03
	Mil	7,561	No Data	No Data	9.6E-04	No Data	No Data	No Data	1.3E-04	No Data	9.5E-04	1.2E-03
F110-GE-100	Idle	1,111	6.6E-03	No Data	2.9E-02	2.0E-03	1.0E-01	No Data	2.4E-03	3.7E-03	1.1E-02	4.2E-03
	Approach	5,080	No Data	No Data	1.8E-03	4.6E-04	1.0E-02	No Data	0.0E+00	4.3E-04	1.3E-03	1.3E-03
	Inter	7,332	1.7E-04	No Data	1.6E-03	4.9E-04	1.9E-02	No Data	0.0E+00	6.1E-04	1.9E-03	1.2E-03
	Mil	11,358	1.5E-04	No Data	1.6E-03	2.5E-04	1.5E-02	No Data	3.3E-04	3.1E-04	7.4E-04	5.9E-04
	Aftburn	18,088	1.2E-02	3.9E-02	1.9E-01	4.5E-02	1.5E-02	5.5E-03	9.7E-02	5.7E-03	1.4E-01	8.9E-02
F117-PW-100	Idle	978	1.2E-02	No Data	2.2E-02	3.0E-03	2.3E-01	No Data	2.4E-03	1.5E-03	6.6E-03	3.2E-03
	Approach	4,645	No Data	No Data	8.9E-04	No Data	1.7E-02	No Data	No Data	No Data	1.4E-03	7.0E-04
	Inter	10,408	No Data	No Data	6.3E-04	No Data	9.5E-03	No Data	No Data	No Data	1.1E-03	5.5E-04
F-118-GE-100	Idle	1,097	7.9E-03	No Data	2.7E-02	1.2E-03	1.8E-01	No Data	0.0E+00	2.3E-03	9.9E-03	5.3E-03
	Approach	3,773	No Data	No Data	8.6E-04	5.0E-04	1.2E-02	No Data	No Data	No Data	1.3E-03	2.1E-03
	Inter	6,350	No Data	No Data	3.7E-04	No Data	1.2E-02	No Data	No Data	No Data	3.0E-04	3.3E-04
	Mil	10,887	No Data	No Data	3.4E-04	No Data	6.6E-03	No Data	No Data	No Data	3.8E-04	2.4E-04
F404-GE-F1D2/400	Idle	685	5.7E-02	1.7E-01	5.2E-01	7.5E-02	1.1E+00	No Data	1.3E-01	8.7E-02	2.6E-01	2.5E-01
	Approach	3,111	No Data	No Data	7.6E-04	4.8E-04	1.7E-02	No Data	3.1E-04	No Data	8.7E-04	2.6E-03
	Inter	6,464	No Data	No Data	6.4E-04	4.0E-04	2.3E-02	No Data	7.0E-05	No Data	1.1E-03	2.0E-03
	Mil	7,739	No Data	No Data	7.4E-04	No Data	9.0E-03	No Data	1.0E-04	No Data	6.6E-04	1.1E-03
	AB	15,851	3.4E-02	1.5E-01	3.7E-01	4.9E-02	3.7E-02	2.2E-02	7.3E-02	5.9E-03	1.8E-01	1.4E-01

Table 3-5. Hazardous Air Pollutant Emission Factors for Aircraft Engines and Auxiliary Power Units (Cont'd)

Engine Model Number	Power Setting	Fuel Flowrate (lb/hr)	Emission Factors in pounds pollutant per 1000 pounds fuel burned (lb/1000 lb)									
			Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methyl Ethyl Ketone	Naphthalene	Styrene	Toluene	Xylenes
T-64-GE-100	Grd Idle	298	5.1E-02	1.1E-01	2.2E-01	2.3E-02	7.2E-02	1.9E-02	5.4E-02	4.1E-02	1.0E-01	6.5E-02
	75% Norm	941	1.2E-03	1.4E-03	1.3E-02	3.1E-04	1.2E-02	3.8E-05	1.5E-03	5.1E-04	2.9E-03	9.7E-04
	Normal	1,698	No Data	No Data	4.0E-03	No Data	3.2E-04	No Data	5.0E-06	No Data	1.3E-04	No Data
	Mil	1,848	No Data	No Data	3.9E-03	No Data	1.8E-04	No Data	2.5E-03	No Data	1.3E-04	No Data
TF34-GE-100A	Idle	498	1.3E-01	6.1E-02	2.9E-01	2.7E-02	1.2E+00	No Data	4.5E-02	4.6E-02	1.2E-01	8.4E-02
	Approach	933	3.1E-02	1.4E-02	6.4E-02	3.5E-03	5.3E-01	No Data	8.5E-03	6.7E-03	1.4E-02	1.2E-02
	Inter	1,512	No Data	5.4E-03	9.6E-03	No Data	6.6E-02	No Data	1.6E-03	No Data	3.2E-03	1.5E-03
	Mil	2,628	No Data	3.0E-03	4.3E-03	9.6E-04	2.8E-02	No Data	3.2E-05	No Data	1.3E-04	3.4E-03

Table 3-6. Average Sulfur Content Values for JP-8 Fuel[a]

Geographic Region[b]	States or Countries[b]	Average Sulfur Content (Weight %)
East Coast U.S.	ME, VT, NH, MA, RI, CT, NY, PA, NJ, DE, MD, VA, WV, NC, SC, GA, FL	0.023
East Central U.S.	ND, SD, MN, IA, NE, WI, MI OH, KY, TN, IN, IL, MO, KS, OK	0.085
Gulf Coast U.S.	AL, MS, AR, LA, TX, NM	0.042
West Central U.S.	MT, ID, WY, UT, CO	0.026
West Coast U.S.	WA, OR, CA, NV, AZ	0.048
Middle East	Kuwait, Bahrain	0.01
European	Europe, Israel, Turkey	0.079
Pacific	Korea, HI, AK, Australia	0.067

[a] Based on average 1996 values obtained from the report titled "Survey of Jet Fuels Aircraft Support Center, 1990 - 1996."

[b] Applies to the location of the refinery which produces the fuel.

Table 3-7. Default Time-in-Mode for Various Aircraft Categories[a]

Aircraft Type	Typical Duration by Mode (minutes)					
	Taxi/ Idle–out	Takeoff	Climbout	Approach	Taxi/ Idle-in	Total
CIVIL AIRCRAFT[b]						
Commercial Carrier						
Jumbo, long and medium range jet	19.0	0.7	2.2	4.0	7.0	32.9
Turboprop	19.0	0.5	2.5	4.5	7.0	33.5
Transport-piston	6.5	0.6	5.0	4.6	6.5	23.2
General Aviation						
Business jet	6.5	0.4	0.1	1.6	6.5	15.5
Turboprop	19.0	Aircraft	2.5	4.5	7.0	33.5
Piston	12.0	0.3	5.0	6.0	4.0	27.3
Helicopter	3.5	-	6.5	6.5	3.5	20.0
MILITARY AIRCRAFT[c]						
Combat[d]						
USAF	18.5	0.4	0.8	3.5	11.3	34.5
USN[e]	6.5	0.4	0.5	1.6	6.5	15.5
Trainer-Turbine						
USAF T-38	12.8	0.4	0.9	3.8	6.4	24.3
USAF general	6.8	0.5	1.4	4.0	4.4	17.1
USN[e]	6.5	0.4	0.5	1.6	6.5	15.5
Transport-Turbine[f]						
USAF general	9.2	0.4	1.2	5.1	6.7	22.6
USN	19.0	0.5	2.5	4.5	7.0	33.5
USAF B-52 and KC-135	32.8	0.7	1.6	5.2	14.9	55.2
Military-Piston	6.5	0.6	5.0	4.6	6.5	23.2
Military-Helicopter	8.0	-	6.8	6.8	7.0	28.6

[a] Source of data is the EPA document "Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources" (AP-42, Volume II)

[b] Civil aircraft data is for large congested metropolitan airports.

[c] USAF = U.S. Air Force; USN = U.S. Navy

[d] Fighters and attack aircraft only.

[e] Time-in-mode is highly variable. Taxi/idle out and in times as high as 25 and 17 minutes, respectively, have been noted. Use local data if possible.

[f] Includes all turbine aircraft not specified elsewhere (i.e., transport, cargo, observation, patrol, antisubmarine, early warning, and utility).

Figure 3-1. Example Data Collection Form for On Wing Engine Testing

Installation Name: **Inventory Year (CY):**
Responsible Organization (Name & Office Symbol):
POC (Name & Phone #):

Building Number / Location	Type of Test Facility*	Type of Aircraft & Engine Tested	Number of Engines Tested During the Year (test/yr)	Average Run Time per Test at Each Power Setting (min/test)	Total Run Time per Test at Each Power Setting [if known] (min/yr)	Average Fuel Flow Rate at Each Power Setting (lb/hr)	Total Fuel Burned During the Year [if known] (lb/yr)
		Aircraft: Engine:		Idle: Approach: Intermediate: Military: Afterburner:	Idle: Approach: Intermediate: Military: Afterburner:	Idle: Approach: Intermediate: Military: Afterburner:	
		Aircraft: Engine:		Idle: Approach: Intermediate: Military: Afterburner:	Idle: Approach: Intermediate: Military: Afterburner:	Idle: Approach: Intermediate: Military: Afterburner:	
		Aircraft: Engine:		Idle: Approach: Intermediate: Military: Afterburner:	Idle: Approach: Intermediate: Military: Afterburner:	Idle: Approach: Intermediate: Military: Afterburner:	

*e.g., Hush House, Trim Pad, etc.

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Figure 3-2. Example Data Collection Form for Aircraft Movements

Installation Name: **Calendar Year (CY):**
Responsible Organization (Name & Office Symbol):
POC (Name & Phone #):

Aircraft Type	Aircraft Number	Date	Number of Landing and Takeoff (LTO) Cycles	Number of Touch and Go (TGO) Cycles	Number of Low Fly By (LFB) Cycles	Number of Low Altitude Flight Patterns (within base air space)	Number of Low Altitude Flight Patterns (outside base air space)*

*Information on Low Altitude Fly Patterns outside Base air space is only required if specifically requested.

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Figure 3-3. Example Data Collection Form for Determining Average Atmospheric Mixing Zone Height

Average Atmospheric Mixing Zone Height

The mixing zone is the layer of the earth's atmosphere where chemical reactions of pollutants can ultimately effect ground level pollutant concentrations. The average mixing zone height is also known as the height of the inversion layer.

(*Organization*) is conducting a survey to determine the pollutant emissions from flightline operations at (*base*). To calculate the emissions, the following data is required.

Office Symbol: _____ Contact: _____

Telephone Number (DSN): _____

Base Altitude: _____ Feet Above Sea Level (ASL)

Average Atmospheric Mixing Zone Height (three year average):

- January through March: _____ Feet
- April through June: _____ Feet
- July through September: _____ Feet
- October through December: _____ Feet

Please send this data to (*name*) at (*e-mail address*) or (*fax number*). Call (*DSN or Commercial Telephone Number*) if you have any questions.

Remarks:

3.5 References

1. U.S. Air Force IERA/RSEQ, Environmental Quality Management Inc., and Roy F. Weston Inc., *Aircraft Engine and Auxiliary Power Unit Testing Report*, IERA-RS-BR-TR-1999-0006, Brooks AFB TX, 1999.

2. U.S. Air Force IERA, *Air Force Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations* (Section 3), May 1999.

3. Defense Energy Support Center, *Survey of Jet Fuels Procured by the Defense Energy Support Center*, 1990 – 1996.

4. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors – Volume II: Mobile Sources* (AP-42, Volume II), February 1980.

5. U.S. Air Force San Antonio Air Logistics Center (SA-ALC/LR), *The Engine Handbook*, 1998.

SECTION 4

ON-ROAD VEHICLES – GENERAL INFORMATION AND METHODOLOGIES

4.1 Background: On-road vehicles at Air Force installations include government owned vehicles (GOVs) and privately owned vehicles (POVs). This section provides general information on on-road vehicles, including the emission factors and equations used to calculate emissions. More specific information/methodologies for calculating emissions from GOVs and POVs are provided in Sections 5 and 6, respectively.

The amount of emissions produced by on-road vehicles (also commonly referred to as "highway vehicles") is dependent on a variety of parameters, such as the type of vehicle, model year, miles driven, average speed, overall mileage (i.e., odometer reading), climate and altitude of location, etc. In regards to the type of vehicle, eight categories are commonly used. These eight vehicle categories are listed in Table 4-1 below.

Table 4-1. Vehicle Type Categories

Vehicle Type Category	Description*
LDGV	Light-duty gasoline-fueled vehicles (i.e., gasoline passenger cars)
LDGT1	Light-duty gasoline-fueled trucks, type 1 (includes gasoline pickup trucks, sport utility vehicles, and vans with a GVW of 6,000 pounds or less)
LDGT2	Light-duty gasoline-fueled trucks, type 2 (includes gasoline pickup trucks, sport utility vehicles, and vans with a GVW from 6,001 to 8,500 pounds)
HDGV	Heavy-duty gasoline-fueled vehicles (includes all gasoline vehicles with a GVW exceeding 8,500 pounds)
LDDV	Light-duty diesel-powered vehicles (i.e., diesel passenger cars)
LDDT	Light-duty diesel-powered trucks (includes diesel pickup trucks, sport utility vehicles, and vans with a GVW of 8,500 pounds or less)
HDDV	Heavy-duty diesel-powered vehicles (includes diesel trucks and buses with a GVW exceeding 8,500 pounds)
MC	Motorcycles

*GVW = Gross Vehicle Weight

Applicable Source Classification Codes include the following:

- SCC A2201001000 Mobile Sources; Highway Vehicles-Gasoline; Light Duty Gasoline Vehicles (LDGV); Total: All Road Types
- SCC A2201020000 Mobile Sources; Highway Vehicles-Gasoline; Light Duty Gasoline Trucks 1 (LDGT1); Total: All Road Types
- SCC A2201040000 Mobile Sources; Highway Vehicles-Gasoline; Light Duty Gasoline Trucks 2 (LDGT2); Total: All Road Types

- SCC A2201070000 Mobile Sources; Highway Vehicles-Gasoline; Heavy Duty Gasoline Vehicles (HDGV); Total: All Road Types
- SCC A2230001000 Mobile Sources; Highway Vehicles-Diesel; Light Duty Diesel Vehicles (LDDV); Total: All Road Types
- SCC A2230060000 Mobile Sources; Highway Vehicles-Diesel; Light Duty Diesel Trucks (LDDT); Total: All Road Types
- SCC A2230070000 Mobile Sources; Highway Vehicles-Diesel; Heavy Duty Diesel Vehicles (HDDV); Total: All Road Types
- SCC A2201080000 Mobile Sources; Highway Vehicles-Gasoline; Motorcycles (MC); Total: All Road Types

4.2 Emission Calculations: Emissions from on-road vehicles are typically calculated by multiplying the estimated vehicle miles traveled times applicable EPA emission factors. Separate calculations are performed for each vehicle category (LDGV, LDGT1, LDDV, etc.) and the results are added together to get the total pollutant emissions. The following equation is used:

$$E_{pol} = [(VMT_{LDGV} * EF_{LDGV}) + (VMT_{LDGT1} * EF_{LDGT1}) + (VMT_{LDGT2} * EF_{LDGT2}) + (VMT_{HDGV} * EF_{HDGV}) + (VMT_{LDDV} * EF_{LDDV}) + (VMT_{LDDT} * EF_{LDDT}) + (VMT_{HDDV} * EF_{HDDV}) + (VMT_{MC} * EF_{MC})] * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
VMT_{XXXX} = Estimated vehicle miles traveled during the year by vehicle category XXXX (miles/yr)
EF_{XXXX} = Applicable pollutant emission factor for vehicle category XXXX (grams/mile) [note: for several pollutants this will be dependent on the vehicle model year]
0.002205 = Factor to convert grams to pounds (lb/gram)

In addition to vehicle category, emission factors for motor vehicles are dependent on several other variables such as model year, mileage, speed, temperature, altitude, fuel properties (e.g., additives, vapor pressure, sulfur content, etc.), possible tampering, possible inspection/maintenance programs, operating mode (i.e., percent operation in cold start, stabilized, and hot start modes), emission control system, etc.

When attempting to estimate the overall emissions from on-road vehicles on an Air Force installation, it is usually not possible (i.e., not practical and/or feasible) to take into consideration many of these parameters, as there are simply too many variables and unknowns associated with the vast number of vehicles traveling on base. Therefore, emissions from on-road vehicles are usually calculated using "typical" (or "average") emission factors. These factors are described in the paragraphs below.

4.2.1 CO, NO_X, and VOC - Typical emission factors for CO, NO_X, and non-methane hydrocarbons are found in Appendix H of AP-42, Volume II (Reference 1). These emission

factors are summarized in Tables 4-2 through 4-49 of this report. Please note that for inventory purposes "non-methane hydrocarbons" is synonymous with "VOC." The only variables associated with these emission factors are altitude of the location the vehicles are driven, model year of the vehicles, and date. In regards to the date, emission factors are listed for January 1st of each calendar year. For conservative purposes, when conducting an inventory for a specific calendar year, you should use the emission factors listed for January 1st of the following calendar year. For example, if you are conducting an inventory for calendar year 2000, you should use the emission factors listed for January 1, 2001. Other (non-variable) parameters, which the emission factors are based on, are listed in the footnotes to each table.

It's important to note that if more specific emission calculations are required (e.g., emissions calculated based on different speeds, temperatures, operating modes, etc.), they can be performed using EPA Mobile Source computer programs. These programs can be obtained from the following internet address: http://www.epa.gov/otaq/models.htm. As of the time this report was being developed, the most current EPA program for calculating CO, NO_X, and VOC emissions from on-road vehicles was MOBILE5. This is a Disk Operating System (DOS) based program which was first made available in the early 1990s. However, the EPA has released the draft version of an updated program (called MOBILE6) which is expected to be finalized sometime in 2001.

4.2.2 Other Criteria Pollutants - Unlike CO, NO_X, and VOC, the EPA does not directly list emission factors for the remaining criteria pollutants which include PM, Lead, PM_{10}, $PM_{2.5}$, and SO_X. Emissions of these pollutants are typically calculated using an EPA Program called PART5. This program is available at the same internet site listed above for the MOBILE5 and MOBILE6 programs. Emission factors for PM, Lead, PM_{10}, $PM_{2.5}$, and SO_X can also be derived manually using the equations/tables found in the Appendix to the PART5 User's Guide. These manual methods are summarized in Subsections 4.2.2.1 through 4.2.2.3 below. Using these methods, average emission factors for PM, Lead, PM_{10}, $PM_{2.5}$, and SO_X were derived by AFIERA/RSEA and are provided in Table 4-50.

4.2.2.1 PM and Lead - Particulate matter emissions from vehicles include exhaust (i.e., tailpipe) emissions and fugitive emissions (i.e., roadway dust, brake wear dust, and tire wear dust). Based on this, the total particulate emission factor for each vehicle category is calculated as follows:

$$EF_{PM\text{-}total,XXXX} = EF_{PM\text{-}exh,XXXX} + EF_{PM\text{-}fug,XXXX}$$

Where,

$EF_{PM\text{-}total,XXXX}$ = Total Particulate Matter emission factor for vehicle category XXXX (g/mi)
$EF_{PM\text{-}exh,XXXX}$ = Exhaust Particulate Matter emission factor for vehicle category XXXX (g/mi)
$EF_{PM\text{-}fug,XXXX}$ = Fugitive Particulate Matter emission factor for vehicle category XXXX (g/mi)

It's important to note that some regulatory agencies do not consider fugitive vehicle particulate emissions to be mobile source emissions, and therefore, the appropriate regulatory agency should

be consulted prior to including these fugitive particulate emissions in a mobile source inventory. It's also important to note that fugitive particulate emissions typically make up a very small (in some cases, insignificant) portion of the total particulate emissions associated with vehicles, and that this should be taken into consideration when determining whether or not fugitive particulate matter emissions should be calculated.

4.2.2.1.1 Exhaust PM and Lead from Gasoline Vehicles - For gasoline vehicles, exhaust PM emissions are a sum of the lead, sulfate, and carbon emissions. Separate methods are used to determine the emission factors for each of these three components, and the values are then added together to obtain the total exhaust PM emission factor. The following equations and data are used:

Exhaust PM Emission Factor Equation for Gasoline Vehicles

$$EF_{PM\text{-}exh,XXXX} = EF_{lead\text{-}exh,XXXX} + EF_{sulfate\text{-}exh,XXXX} + EF_{carbon\text{-}exh,XXXX}$$

Where,

$EF_{lead\text{-}exh,XXXX}$ = Exhaust Lead emission factor for vehicle category XXXX (g/mi)
$EF_{sulfate\text{-}exh,XXXX}$ = Exhaust Sulfate emission factor for vehicle category XXXX (g/mi)
$EF_{carbon\text{-}exh,XXXX}$ = Exhaust Carbon emission factor for vehicle category XXXX (g/mi)

Exhaust Lead Emission Factor Equation for Gasoline Vehicles

$$EF_{lead\text{-}exh,XXXX} = (ABURN * PWR / FE_{XXXX}) * PB$$

Where,

ABURN = Fraction of lead burned that is exhausted [note: 0.44 is used for catalyst vehicles using unleaded gasoline, while 0.75 is used for non-catalyst vehicles (i.e., motorcycles) using unleaded gasoline]
PWR = Particle weight ratio [note: use PbClBr/Pb = 1.557]
FE_{XXXX} = Fuel economy for vehicle category XXXX (mi/gal) [note: see Table 4-51 for default values]
PB = Fuel lead content (g/gal) [note: 0.05 is the maximum for unleaded gasoline]

Exhaust Sulfate Emission Factor Equation for Gasoline Vehicles

$$EF_{sulfate\text{-}exh,XXXX} = [(1.0 + WATER) * FDNSTY * SWGHT * DSNVRT]* 13.6078 / FE_{XXXX}$$

Where,

WATER = Weight ratio of seven water molecules to sulfate [7.18/98 = 1.2857]
FDNSTY = Fuel Density (lb/gal) [note: 6.09 is the default used for gasoline]
SWGHT = Weight percent sulfur in the fuel [note: use 0.03 as a default for gasoline]
DCNVRT = Fraction of sulfur in the fuel which is directly converted into sulfate (note: use 0.02 as a default]
13.6078 = Unit Conversion Factor [note: this incorporates conversion of pounds to grams, weight ratio of SO_4 to sulfur, and a conversion of percent to a fraction]
FE_{XXXX} = Fuel economy for vehicle category XXXX (mi/gal) [note: see Table 4-51 for default values]

Exhaust Carbon Emission Factors for Gasoline Vehicle

Default exhaust carbon emission factors for each gasoline vehicle category are listed in Table 4-52.

4.2.2.1.2 Exhaust PM and Lead from Diesel Vehicles - For diesel vehicles, exhaust PM emission factors are listed directly in Table 2 of the Appendix to the PART5 User's Guide and are also provided in Table 4-53 of this document. It's important to note, however, that these emission factors are conservatively high, since they are based on the use of high sulfur (0.25%) diesel fuel instead of low sulfur (0.05%) diesel fuel [note: as of 1993, only low sulfur diesel fuel can be used by on-road vehicles operating in the United States].

Since the lead content of diesel fuel is negligible, no lead emissions are calculated for diesel vehicles.

4.2.2.1.3 Fugitive PM Emissions - Fugitive particulate matter emissions from all on-road vehicles include roadway dust, brake wear dust, and tire wear dust [note – as mentioned previously under subsection 4.2.2.1, fugitive particulate matter emissions are sometimes not required to be included in mobile source air emission inventories]. Methods used to calculate these fugitive PM emissions are found in the Appendix to the PART5 User's Guide. The applicable equations are listed below:

Fugitive PM Emission Factor Equation

$$EF_{PM\text{-}fug,XXXX} = EF_{RD} + EF_{BW} + EF_{TW,XXXX}$$

Where,

EF_{RD} = Road Dust emission factor (g/mi)
EF_{BW} = Break Wear emission factor (g/mi)
$EF_{TW,XXXX}$ = Tire Wear emission factor for vehicle category (g/mi)

Road Dust Emission Factor Equation for *Paved* Roads

$$EF_{RD} = BEF * (SL/2)^{0.65} * (W/3)^{1.5}$$

Where,

BEF = Base Emission Factor (g/mi) [note: use 38 for PM, 7.3 for PM_{10}, and 1.8 for $PM_{2.5}$]
SL = Road Surface Silt Loading (g/m^2) [note: if unknown, an average value of 0.26 can be used]
W = Average weight of vehicles traveling the road (tons) [note: if unknown, use estimates listed in Table 4-54]

Road Dust Emission Factor Equation for *Unpaved* Roads

$$EF_{RD} = [k * (s/12)^a * (W/3)^b) / (M_{dry}/0.2)^c] * [(365 - p)/365] * 453.59$$

Where,

k = Constant (lb/mi) [note: use 10 for PM, 2.6 for PM_{10}, and 0.38 for $PM_{2.5}$]
a = Constant (unitless) [note: use 0.8 for PM, PM_{10}, and $PM_{2.5}$]
b = Constant (unitless) [note: use 0.5 for PM, and 0.4 for both PM_{10} and $PM_{2.5}$]
c = Constant (unitless) [note: use 0.4 for PM, and 0.3 for both PM_{10} and $PM_{2.5}$]
s = Surface Material Silt Content (%) [note: if unknown, use applicable mean value listed in Table 4-55]
W = Average weight of vehicles traveling the road (tons) [note: if unknown, use estimates listed in Table 4-54]
M_{dry} = Surface material moisture content under dry, uncontrolled conditions (%) [note: if unknown use a default value of 0.2]
p = Number of days with at least 0.01 inches of precipitation per year [note: this value can be obtained from the base Weather Detachment or from the local community Weather Service]
453.59 = Conversion factor (g/lb)

Break Wear Emission Factor

The PM Break Wear emission factor for all vehicles is 0.0128 g/mi.

Tire Wear Emission Factor Equation

$$EF_{TW,XXXX} = 0.002 * IVEHWL_{XXXX}$$

Where,

0.002 = Emission Rate of airborne particulates from tire wear for light duty vehicles
$IVEHWL_{XXXX}$ = Average number of wheels on vehicles of category XXXX [note: use 2 for motorcycles, 6 for HDDV, and 4 for all other vehicle categories]

4.2.2.2 PM_{10} and $PM_{2.5}$ - PM_{10} emission factors are derived by simply multiplying the applicable PM emission factor times the appropriate PM_{10} to PM fraction. Likewise, $PM_{2.5}$ emission factors are derived by simply multiplying the applicable PM emission factor times the appropriate $PM_{2.5}$ to PM fraction. PM_{10} to PM fractions and $PM_{2.5}$ to PM fractions are listed in Table 4 of the Appendix to the PART5 User's Guide, and are also provided in Table 4-56 of this report. As an alternative, PM_{10} and $PM_{2.5}$ emissions associated with road dust (from both paved and unpaved roads) can also be calculated using the applicable equations above and the parameters specific to PM_{10} and $PM_{2.5}$.

4.2.2.3 SO_X - SO_X emission factors are derived based on the assumption that all the sulfur in the fuel is exhausted as either sulfate or gaseous sulfur dioxide (SO_2), and that the SO_X emissions are essentially equal to the SO_2 emissions. The SO_X emission factors are calculated using the SO_2 emission factor equation found in the Appendix to the PART5 User's Guide. The variables in this equation include fuel density, fuel sulfur content, percent of sulfur converted directly into sulfate, and vehicle fuel economy. The equation is as follows:

$$EF_{SOx,XXXX} = [FDNSTY * SWGHT * (1 - DCNVRT) * 9.072] / FE_{XXXX}$$

Where,

$EF_{SOx,XXXX}$ = SO_X Emission Factor for vehicle category XXXX (g/mi)
FDNSTY = Fuel Density (lb/gal) [note: 6.09 is the default used for gasoline while 7.11 is the default for diesel]
SWGHT = Weight percent sulfur in the fuel [note: use 0.03 as a default for gasoline and 0.05 as a default for diesel]
DCNVRT = Fraction of sulfur in the fuel which is directly converted into sulfate (note: use 0.02 as a default]
9.072 = Unit Conversion Factor [note: this incorporates conversion of pounds to grams, weight ratio of SO_2 to sulfur, and a conversion of percent to a fraction]
FE_{XXXX} = Fuel economy for vehicle category XXXX (mi/gal) [note: see Table 4-51 for default values]

4.2.3 Hazardous Air Pollutants: Most of the HAP emissions from on-road vehicles are in the form of specific organic compounds such as benzene and formaldehyde. Emission factors for calculating organic HAP emissions are provided in Tables 4-57 through 4-61. These emission factors were extrapolated based on values found in an EPA report titled "*Analysis of the Impacts of Control Programs on Motor Vehicle Toxics Emissions and Exposure in Urban Areas and Nationwide: Volume II: Detailed Toxics Emissions and Exposure Estimates*" (Reference 8). The

emission factors are dependent on calendar year and vehicle category, but are not dependent on model year or altitude.

In addition to organic HAPs, small amounts of inorganic metal HAPs may also be emitted from on-road vehicles. The main inorganic HAP of concern is lead, which is primarily emitted from gasoline-fueled vehicles. Methodology for calculated lead emissions is addressed in Subsection 4.2.2.1 above.

4.2.4 Idle Emissions: There may be some vehicles on an Air Force installation which typically spend a large amount of time operating in the idle mode, as opposed to actually being driven. Examples include security vehicles located at controlled areas, various flightline vehicles (e.g., flightline safety and flightline management vehicles), buses at on-base bus stops, certain delivery vehicles, etc. Since these vehicles spend a significant amount of time idling instead of traveling, the methodology and emission factors addressed above are not appropriate because they're based on vehicle miles driven. Therefore, for idling vehicles (i.e., vehicles which spend most of their operating time idling), emissions should also be calculated based on idling time. The following equation is used:

$$E_{pol} = VIT * EF * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
VIT = Estimated vehicle idling time during the year (hr/yr)
EF = Applicable pollutant emission factor (grams/hr)
0.002205 = Factor to convert grams to pounds (lb/gram)

EPA idle emission factors for both winter conditions and summer conditions are listed in Tables 4-62 and 4-63, respectively. Table 4-64 provides an average of the values found in Tables 4-62 and 4-63.

4.3 Information Resources: Information resources specific to calculating emissions from GOVs and POVs are cited in Sections 5 and 6, respectively.

4.4 Example Calculations: Example calculations specific to calculating emissions from GOVs and POVs are cited in Sections 5 and 6, respectively.

Table 4-2. VOC Emission Factors for Low Altitude LDGV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	10.3	1977	10.2	1978	9.6	1979	9.6	1980	7.3	1981	7.5	1982	7.3	1983	7.1	1984	7.2	1985	7.2	1986	7.1
1977	10.0	1978	9.3	1979	9.4	1980	7.1	1981	7.2	1982	7.1	1983	6.9	1984	6.9	1985	7.0	1986	6.9	1987	6.7
1978	9.1	1979	9.1	1980	6.9	1981	7.0	1982	6.8	1983	6.7	1984	6.7	1985	6.7	1986	6.7	1987	6.4	1988	6.3
1979	8.9	1980	6.6	1981	6.8	1982	6.6	1983	6.5	1984	6.5	1985	6.5	1986	6.5	1987	6.2	1988	6.1	1989	6.3
1980	6.4	1981	6.5	1982	6.4	1983	6.3	1984	6.2	1985	6.3	1986	6.2	1987	5.9	1988	5.9	1989	6.1	1990	6.1
1981	6.3	1982	6.1	1983	6.0	1984	6.0	1985	6.0	1986	6.0	1987	5.7	1988	5.7	1989	5.9	1990	5.9	1991	5.9
1982	5.9	1983	5.8	1984	5.8	1985	5.8	1986	5.8	1987	5.5	1988	5.4	1989	5.6	1990	5.7	1991	5.6	1992	5.7
1983	5.5	1984	5.5	1985	5.5	1986	5.5	1987	5.2	1988	5.2	1989	5.4	1990	5.4	1991	5.4	1992	5.4	1993	5.4
1984	5.3	1985	5.3	1986	5.2	1987	5.0	1988	5.0	1989	5.1	1990	5.2	1991	5.1	1992	5.2	1993	5.1	1994	5.1
1985	5.0	1986	4.9	1987	4.7	1988	4.7	1989	4.9	1990	4.9	1991	4.9	1992	4.9	1993	4.9	1994	4.8	1995	4.8
1986	4.6	1987	4.5	1988	4.4	1989	4.6	1990	4.6	1991	4.6	1992	4.6	1993	4.6	1994	4.6	1995	4.5	1996	4.4
1987	4.2	1988	4.1	1989	4.3	1990	4.3	1991	4.3	1992	4.3	1993	4.3	1994	4.2	1995	4.2	1996	4.1	1997	4.0
1988	3.8	1989	4.0	1990	4.0	1991	4.0	1992	4.0	1993	4.0	1994	3.9	1995	3.8	1996	3.8	1997	3.7	1998	3.6
1989	3.6	1990	3.7	1991	3.7	1992	3.7	1993	3.6	1994	3.6	1995	3.5	1996	3.5	1997	3.4	1998	3.2	1999	3.2
1990	3.3	1991	3.4	1992	3.4	1993	3.3	1994	3.2	1995	3.2	1996	3.2	1997	3.1	1998	2.9	1999	2.9	2000	2.9
1991	3.0	1992	3.0	1993	3.0	1994	2.9	1995	2.9	1996	2.8	1997	2.8	1998	2.6	1999	2.6	2000	2.6	2001	2.6
1992	2.6	1993	2.6	1994	2.6	1995	2.5	1996	2.4	1997	2.4	1998	2.2	1999	2.2	2000	2.2	2001	2.2	2002	2.2
1993	2.2	1994	2.2	1995	2.1	1996	2.0	1997	2.0	1998	1.8	1999	1.8	2000	1.8	2001	1.8	2002	1.8	2003	1.8
1994	1.8	1995	1.7	1996	1.6	1997	1.6	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4
1995	1.3	1996	1.1	1997	1.2	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0
1996	0.8	1997	0.7	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6
1997	0.6	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 1.11A.1 minus the uncontrolled refueling values in Table 1.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-3. CO Emission Factors for Low Altitude LDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	70.6	1977	70.6	1978	70.8	1979	70.8	1980	48.0	1981	69.3	1982	65.1	1983	64.6	1984	66.8	1985	66.4	1986	65.7
1977	69.5	1978	69.7	1979	69.7	1980	47.1	1981	67.7	1982	63.6	1983	63.1	1984	65.1	1985	64.8	1986	64.2	1987	61.8
1978	68.6	1979	68.6	1980	46.2	1981	66.0	1982	62.0	1983	61.6	1984	63.5	1985	63.1	1986	62.5	1987	60.3	1988	58.5
1979	67.4	1980	45.2	1981	64.2	1982	60.4	1983	59.9	1984	61.7	1985	61.4	1986	60.7	1987	58.6	1988	56.9	1989	59.1
1980	44.2	1981	62.3	1982	58.7	1983	58.2	1984	59.8	1985	59.5	1986	58.9	1987	56.7	1988	55.2	1989	57.3	1990	57.3
1981	60.3	1982	56.8	1983	56.4	1984	57.8	1985	57.6	1986	56.9	1987	54.9	1988	53.3	1989	55.4	1990	55.4	1991	55.6
1982	54.9	1983	54.4	1984	55.7	1985	55.5	1986	54.9	1987	52.9	1988	51.4	1989	53.4	1990	53.4	1991	53.6	1992	53.8
1983	52.4	1984	53.5	1985	53.3	1986	52.7	1987	50.8	1988	49.4	1989	51.3	1990	51.3	1991	51.5	1992	51.7	1993	51.7
1984	51.2	1985	51.0	1986	50.4	1987	48.6	1988	47.3	1989	49.1	1990	49.0	1991	49.2	1992	49.5	1993	49.5	1994	49.5
1985	48.5	1986	47.9	1987	46.3	1988	45.0	1989	46.7	1990	46.7	1991	46.9	1992	47.1	1993	47.1	1994	47.1	1995	47.1
1986	45.3	1987	43.8	1988	42.6	1989	44.2	1990	44.2	1991	44.4	1992	44.6	1993	44.6	1994	44.6	1995	44.6	1996	44.6
1987	41.2	1988	40.1	1989	41.6	1990	41.6	1991	41.8	1992	42.0	1993	42.0	1994	42.0	1995	42.0	1996	42.0	1997	42.0
1988	37.4	1989	38.8	1990	38.8	1991	39.0	1992	39.2	1993	39.2	1994	39.2	1995	39.2	1996	39.2	1997	39.2	1998	39.2
1989	35.9	1990	35.9	1991	36.1	1992	36.2	1993	36.2	1994	36.2	1995	36.2	1996	36.2	1997	36.2	1998	36.2	1999	36.2
1990	32.8	1991	33.0	1992	33.1	1993	33.1	1994	33.1	1995	33.1	1996	33.1	1997	33.1	1998	33.1	1999	33.1	2000	33.1
1991	29.7	1992	29.8	1993	29.8	1994	29.8	1995	29.8	1996	29.8	1997	29.8	1998	29.8	1999	29.8	2000	29.8	2001	29.8
1992	26.3	1993	26.3	1994	26.3	1995	26.3	1996	26.3	1997	26.3	1998	26.3	1999	26.3	2000	26.3	2001	26.3	2002	26.3
1993	22.6	1994	22.6	1995	22.6	1996	22.6	1997	22.6	1998	22.6	1999	22.6	2000	22.6	2001	22.6	2002	22.6	2003	22.6
1994	18.7	1995	18.7	1996	18.7	1997	18.7	1998	18.7	1999	18.7	2000	18.7	2001	18.7	2002	18.7	2003	18.7	2004	18.7
1995	14.6	1996	14.6	1997	14.6	1998	14.6	1999	14.6	2000	14.6	2001	14.6	2002	14.6	2003	14.6	2004	14.6	2005	14.6
1996	10.2	1997	10.2	1998	10.2	1999	10.2	2000	10.2	2001	10.2	2002	10.2	2003	10.2	2004	10.2	2005	10.2	2006	10.2
1997	8.3	1998	8.3	1999	8.3	2000	8.3	2001	8.3	2002	8.3	2003	8.3	2004	8.3	2005	8.3	2006	8.3	2007	8.3
1998	6.2	1999	6.2	2000	6.2	2001	6.2	2002	6.2	2003	6.2	2004	6.2	2005	6.2	2006	6.2	2007	6.2	2008	6.2
1999	4.0	2000	4.0	2001	4.0	2002	4.0	2003	4.0	2004	4.0	2005	4.0	2006	4.0	2007	4.0	2008	4.0	2009	4.0
2000	2.6	2001	2.6	2002	2.6	2003	2.6	2004	2.6	2005	2.6	2006	2.6	2007	2.6	2008	2.6	2009	2.6	2010	2.6

[a] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 1.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-4. NO_X Emission Factors for Low Altitude LDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	3.2	1977	3.9	1978	3.9	1979	3.9	1980	3.5	1981	4.2	1982	4.2	1983	4.3	1984	4.8	1985	4.5	1986	4.6
1977	3.9	1978	3.8	1979	3.9	1980	3.5	1981	4.1	1982	4.1	1983	4.2	1984	4.6	1985	4.4	1986	4.5	1987	4.4
1978	3.8	1979	3.8	1980	3.4	1981	4.0	1982	4.1	1983	4.1	1984	4.5	1985	4.3	1986	4.4	1987	4.3	1988	4.2
1979	3.8	1980	3.3	1981	3.9	1982	4.0	1983	4.0	1984	4.4	1985	4.2	1986	4.2	1987	4.2	1988	4.1	1989	4.1
1980	3.3	1981	3.8	1982	3.8	1983	3.9	1984	4.3	1985	4.1	1986	4.1	1987	4.2	1988	4.0	1989	3.9	1990	3.8
1981	3.7	1982	3.7	1983	3.8	1984	4.2	1985	3.9	1986	4.0	1987	4.0	1988	3.9	1989	3.8	1990	3.7	1991	3.7
1982	3.6	1983	3.7	1984	4.0	1985	3.8	1986	3.8	1987	3.9	1988	3.7	1989	3.7	1990	3.6	1991	3.5	1992	3.5
1983	3.6	1984	3.9	1985	3.7	1986	3.7	1987	3.8	1988	3.6	1989	3.5	1990	3.5	1991	3.4	1992	3.4	1993	3.4
1984	3.7	1985	3.6	1986	3.6	1987	3.6	1988	3.5	1989	3.4	1990	3.3	1991	3.3	1992	3.3	1993	3.3	1994	3.2
1985	3.4	1986	3.5	1987	3.4	1988	3.3	1989	3.3	1990	3.2	1991	3.1	1992	3.2	1993	3.2	1994	3.0	1995	3.0
1986	3.3	1987	3.3	1988	3.1	1989	3.1	1990	3.1	1991	3.0	1992	3.1	1993	3.0	1994	2.9	1995	2.9	1996	2.8
1987	3.1	1988	3.0	1989	2.9	1990	2.9	1991	2.9	1992	2.9	1993	2.9	1994	2.7	1995	2.7	1996	2.6	1997	2.6
1988	2.8	1989	2.8	1990	2.7	1991	2.7	1992	2.7	1993	2.7	1994	2.6	1995	2.5	1996	2.4	1997	2.4	1998	2.4
1989	2.6	1990	2.6	1991	2.5	1992	2.5	1993	2.5	1994	2.4	1995	2.3	1996	2.3	1997	2.3	1998	2.3	1999	2.3
1990	2.4	1991	2.4	1992	2.4	1993	2.3	1994	2.3	1995	2.1	1996	2.1	1997	2.1	1998	2.1	1999	2.1	2000	2.1
1991	2.2	1992	2.2	1993	2.1	1994	2.1	1995	1.9	1996	1.9	1997	1.9	1998	1.9	1999	1.9	2000	1.9	2001	1.9
1992	2.0	1993	1.9	1994	1.8	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7	2000	1.7	2001	1.7	2002	1.7
1993	1.7	1994	1.6	1995	1.5	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4
1994	1.4	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2
1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0
1996	0.7	1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 1.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-5. VOC Emission Factors for High Altitude LDGV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	11.8	1977	10.1	1978	11.0	1979	11.0	1980	8.0	1981	8.0	1982	7.5	1983	7.4	1984	7.2	1985	7.2	1986	7.1
1977	9.9	1978	10.8	1979	10.7	1980	7.8	1981	7.7	1982	7.3	1983	7.2	1984	6.9	1985	7.0	1986	6.9	1987	6.7
1978	10.5	1979	10.5	1980	7.5	1981	7.5	1982	7.0	1983	7.0	1984	6.7	1985	6.7	1986	6.7	1987	6.5	1988	6.4
1979	10.2	1980	7.3	1981	7.2	1982	6.8	1983	6.7	1984	6.5	1985	6.5	1986	6.4	1987	6.3	1988	6.1	1989	6.4
1980	7.0	1981	7.0	1982	6.6	1983	6.5	1984	6.2	1985	6.3	1986	6.2	1987	6.1	1988	5.9	1989	6.1	1990	6.2
1981	6.7	1982	6.3	1983	6.2	1984	6.0	1985	6.0	1986	6.0	1987	5.8	1988	5.6	1989	5.9	1990	5.9	1991	6.0
1982	6.1	1983	6.0	1984	5.7	1985	5.8	1986	5.7	1987	5.6	1988	5.4	1989	5.7	1990	5.7	1991	5.7	1992	5.8
1983	5.7	1984	5.5	1985	5.5	1986	5.5	1987	5.4	1988	5.2	1989	5.4	1990	5.4	1991	5.5	1992	5.4	1993	5.5
1984	5.2	1985	5.3	1986	5.2	1987	5.1	1988	4.9	1989	5.2	1990	5.1	1991	5.2	1992	5.2	1993	5.3	1994	5.2
1985	5.0	1986	5.0	1987	4.8	1988	4.7	1989	4.9	1990	4.9	1991	5.0	1992	5.0	1993	5.0	1994	4.9	1995	4.8
1986	4.7	1987	4.5	1988	4.4	1989	4.6	1990	4.6	1991	4.7	1992	4.7	1993	4.7	1994	4.6	1995	4.5	1996	4.4
1987	4.2	1988	4.2	1989	4.3	1990	4.3	1991	4.3	1992	4.4	1993	4.4	1994	4.3	1995	4.2	1996	4.1	1997	4.1
1988	3.9	1989	4.0	1990	4.0	1991	4.0	1992	4.0	1993	4.1	1994	4.0	1995	3.9	1996	3.8	1997	3.7	1998	3.6
1989	3.7	1990	3.7	1991	3.7	1992	3.7	1993	3.8	1994	3.7	1995	3.6	1996	3.4	1997	3.4	1998	3.3	1999	3.3
1990	3.4	1991	3.4	1992	3.4	1993	3.4	1994	3.4	1995	3.3	1996	3.1	1997	3.1	1998	3.0	1999	2.9	2000	2.9
1991	3.0	1992	3.0	1993	3.0	1994	3.0	1995	2.9	1996	2.8	1997	2.8	1998	2.6	1999	2.6	2000	2.6	2001	2.6
1992	2.6	1993	2.6	1994	2.6	1995	2.5	1996	2.5	1997	2.4	1998	2.2	1999	2.2	2000	2.2	2001	2.2	2002	2.2
1993	2.2	1994	2.2	1995	2.1	1996	2.1	1997	2.0	1998	1.9	1999	1.9	2000	1.9	2001	1.9	2002	1.9	2003	1.9
1994	1.8	1995	1.7	1996	1.7	1997	1.6	1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5
1995	1.3	1996	1.3	1997	1.2	1998	1.1	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0
1996	0.8	1997	0.7	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6
1997	0.6	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table1.11A.2 minus the uncontrolled refueling values in Table 1.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-6. CO Emission Factors for High Altitude LDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	102.0	1977	72.6	1978	96.8	1979	96.8	1980	66.1	1981	79.0	1982	70.7	1983	64.8	1984	66.8	1985	66.4	1986	65.7
1977	71.5	1978	95.7	1979	95.7	1980	65.2	1981	77.4	1982	69.2	1983	63.3	1984	65.1	1985	64.8	1986	64.2	1987	61.8
1978	94.6	1979	94.6	1980	64.3	1981	75.7	1982	67.6	1983	61.7	1984	63.5	1985	63.1	1986	62.5	1987	60.3	1988	58.5
1979	93.4	1980	63.3	1981	73.9	1982	66.0	1983	60.1	1984	61.7	1985	61.4	1986	60.7	1987	58.6	1988	56.9	1989	59.1
1980	62.3	1981	72.0	1982	64.3	1983	58.3	1984	59.8	1985	59.5	1986	58.9	1987	56.7	1988	55.2	1989	57.3	1990	57.3
1981	70.0	1982	62.4	1983	56.4	1984	57.8	1985	57.6	1986	56.9	1987	54.9	1988	53.3	1989	55.4	1990	55.4	1991	55.6
1982	60.5	1983	54.5	1984	55.7	1985	55.5	1986	54.9	1987	52.9	1988	51.4	1989	53.4	1990	53.4	1991	53.6	1992	53.8
1983	52.4	1984	53.5	1985	53.3	1986	52.7	1987	50.8	1988	49.4	1989	51.3	1990	51.3	1991	51.5	1992	51.7	1993	51.7
1984	51.2	1985	51.0	1986	50.4	1987	48.6	1988	47.3	1989	49.1	1990	49.0	1991	49.2	1992	49.5	1993	49.5	1994	49.5
1985	48.5	1986	47.9	1987	46.3	1988	45.0	1989	46.7	1990	46.7	1991	46.9	1992	47.1	1993	47.1	1994	47.1	1995	47.1
1986	45.3	1987	43.8	1988	42.6	1989	44.2	1990	44.2	1991	44.4	1992	44.6	1993	44.6	1994	44.6	1995	44.6	1996	44.6
1987	41.2	1988	40.1	1989	41.6	1990	41.6	1991	41.8	1992	42.0	1993	42.0	1994	42.0	1995	42.0	1996	42.0	1997	42.0
1988	37.4	1989	38.8	1990	38.8	1991	39.0	1992	39.2	1993	39.2	1994	39.2	1995	39.2	1996	39.2	1997	39.2	1998	39.2
1989	35.9	1990	35.9	1991	36.1	1992	36.2	1993	36.2	1994	36.2	1995	36.2	1996	36.2	1997	36.2	1998	36.2	1999	36.2
1990	32.8	1991	33.0	1992	33.1	1993	33.1	1994	33.1	1995	33.1	1996	33.1	1997	33.1	1998	33.1	1999	33.1	2000	33.1
1991	29.7	1992	29.8	1993	29.8	1994	29.8	1995	29.8	1996	29.8	1997	29.8	1998	29.8	1999	29.8	2000	29.8	2001	29.8
1992	26.3	1993	26.3	1994	26.3	1995	26.3	1996	26.3	1997	26.3	1998	26.3	1999	26.3	2000	26.3	2001	26.3	2002	26.3
1993	22.6	1994	22.6	1995	22.6	1996	22.6	1997	22.6	1998	22.6	1999	22.6	2000	22.6	2001	22.6	2002	22.6	2003	22.6
1994	18.7	1995	18.7	1996	18.7	1997	18.7	1998	18.7	1999	18.7	2000	18.7	2001	18.7	2002	18.7	2003	18.7	2004	18.7
1995	14.6	1996	14.6	1997	14.6	1998	14.6	1999	14.6	2000	14.6	2001	14.6	2002	14.6	2003	14.6	2004	14.6	2005	14.6
1996	10.2	1997	10.2	1998	10.2	1999	10.2	2000	10.2	2001	10.2	2002	10.2	2003	10.2	2004	10.2	2005	10.2	2006	10.2
1997	8.3	1998	8.3	1999	8.3	2000	8.3	2001	8.3	2002	8.3	2003	8.3	2004	8.3	2005	8.3	2006	8.3	2007	8.3
1998	6.2	1999	6.2	2000	6.2	2001	6.2	2002	6.2	2003	6.2	2004	6.2	2005	6.2	2006	6.2	2007	6.2	2008	6.2
1999	4.0	2000	4.0	2001	4.0	2002	4.0	2003	4.0	2004	4.0	2005	4.0	2006	4.0	2007	4.0	2008	4.0	2009	4.0
2000	2.6	2001	2.6	2002	2.6	2003	2.6	2004	2.6	2005	2.6	2006	2.6	2007	2.6	2008	2.6	2009	2.6	2010	2.6

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 1.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-7. NO_X Emission Factors for High Altitude LDGV[a]

January 1 of Calendar Year																			
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	2.5	1977	3.6	1978	3.1	1979	3.1	1980	2.8	1981	4.1	1982	4.2	1983	4.6	1984	4.8	1985	4.5	1986	4.6
1977	3.5	1978	3.0	1979	3.1	1980	2.8	1981	4.0	1982	4.1	1983	4.5	1984	4.6	1985	4.4	1986	4.5	1987	4.4
1978	3.0	1979	3.0	1980	2.8	1981	3.9	1982	4.0	1983	4.4	1984	4.5	1985	4.3	1986	4.4	1987	4.3	1988	4.2
1979	3.0	1980	2.7	1981	3.8	1982	3.9	1983	4.2	1984	4.4	1985	4.2	1986	4.2	1987	4.2	1988	4.1	1989	4.1
1980	2.7	1981	3.7	1982	3.8	1983	4.1	1984	4.3	1985	4.1	1986	4.1	1987	4.2	1988	4.0	1989	3.9	1990	3.8
1981	3.6	1982	3.7	1983	4.1	1984	4.2	1985	3.9	1986	4.0	1987	4.0	1988	3.9	1989	3.8	1990	3.7	1991	3.7
1982	3.6	1983	3.9	1984	4.0	1985	3.8	1986	3.8	1987	3.9	1988	3.7	1989	3.7	1990	3.6	1991	3.5	1992	3.5
1983	3.8	1984	3.9	1985	3.7	1986	3.7	1987	3.8	1988	3.6	1989	3.5	1990	3.5	1991	3.4	1992	3.4	1993	3.4
1984	3.7	1985	3.6	1986	3.6	1987	3.6	1988	3.5	1989	3.4	1990	3.3	1991	3.3	1992	3.3	1993	3.3	1994	3.2
1985	3.4	1986	3.5	1987	3.4	1988	3.3	1989	3.3	1990	3.2	1991	3.1	1992	3.2	1993	3.2	1994	3.0	1995	3.0
1986	3.3	1987	3.3	1988	3.1	1989	3.1	1990	3.1	1991	3.0	1992	3.1	1993	3.0	1994	2.9	1995	2.9	1996	2.8
1987	3.1	1988	3.0	1989	2.9	1990	2.9	1991	2.9	1992	2.9	1993	2.9	1994	2.7	1995	2.7	1996	2.6	1997	2.6
1988	2.8	1989	2.8	1990	2.7	1991	2.7	1992	2.7	1993	2.7	1994	2.6	1995	2.5	1996	2.4	1997	2.4	1998	2.4
1989	2.6	1990	2.6	1991	2.5	1992	2.5	1993	2.5	1994	2.4	1995	2.3	1996	2.3	1997	2.3	1998	2.3	1999	2.3
1990	2.4	1991	2.4	1992	2.4	1993	2.3	1994	2.3	1995	2.1	1996	2.1	1997	2.1	1998	2.1	1999	2.1	2000	2.1
1991	2.2	1992	2.2	1993	2.1	1994	2.1	1995	1.9	1996	1.9	1997	1.9	1998	1.9	1999	1.9	2000	1.9	2001	1.9
1992	2.0	1993	1.9	1994	1.8	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7	2000	1.7	2001	1.7	2002	1.7
1993	1.7	1994	1.6	1995	1.5	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4
1994	1.4	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2
1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0
1996	0.7	1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 1.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-8. VOC Emission Factors for Low Altitude LDGT1[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	11.4	1977	11.3	1978	10.3	1979	9.7	1980	9.6	1981	6.4	1982	6.3	1983	6.4	1984	6.3	1985	7.7	1986	7.6
1977	11.0	1978	10.0	1979	9.4	1980	9.4	1981	6.1	1982	6.2	1983	6.3	1984	6.0	1985	7.5	1986	7.3	1987	7.1
1978	9.8	1979	9.2	1980	9.1	1981	6.0	1982	5.9	1983	6.1	1984	5.9	1985	7.2	1986	7.1	1987	6.8	1988	6.7
1979	8.9	1980	8.9	1981	5.8	1982	5.8	1983	5.9	1984	5.7	1985	7.0	1986	6.8	1987	6.6	1988	6.4	1989	6.6
1980	8.6	1981	5.7	1982	5.6	1983	5.7	1984	5.6	1985	6.8	1986	6.6	1987	6.4	1988	6.2	1989	6.4	1990	6.4
1981	5.5	1982	5.5	1983	5.5	1984	5.4	1985	6.4	1986	6.4	1987	6.1	1988	6.0	1989	6.2	1990	6.2	1991	6.2
1982	5.3	1983	5.3	1984	5.2	1985	6.2	1986	6.0	1987	5.9	1988	5.7	1989	5.9	1990	6.0	1991	5.9	1992	6.0
1983	5.1	1984	5.0	1985	5.9	1986	5.8	1987	5.7	1988	5.5	1989	5.6	1990	5.7	1991	5.7	1992	5.8	1993	5.7
1984	4.8	1985	5.7	1986	5.5	1987	5.4	1988	5.3	1989	5.4	1990	5.5	1991	5.5	1992	5.5	1993	5.5	1994	5.4
1985	5.4	1986	5.3	1987	5.1	1988	5.0	1989	5.1	1990	5.2	1991	5.2	1992	5.2	1993	5.2	1994	5.1	1995	5.0
1986	5.0	1987	4.8	1988	4.7	1989	4.8	1990	4.9	1991	4.9	1992	4.9	1993	4.9	1994	4.8	1995	4.7	1996	4.6
1987	4.5	1988	4.4	1989	4.5	1990	4.6	1991	4.6	1992	4.6	1993	4.6	1994	4.5	1995	4.4	1996	4.3	1997	4.2
1988	4.1	1989	4.2	1990	4.3	1991	4.3	1992	4.4	1993	4.3	1994	4.2	1995	4.1	1996	4.0	1997	3.9	1998	3.8
1989	3.9	1990	4.0	1991	4.0	1992	4.0	1993	4.0	1994	3.9	1995	3.7	1996	3.7	1997	3.6	1998	3.4	1999	3.4
1990	3.6	1991	3.6	1992	3.6	1993	3.6	1994	3.5	1995	3.4	1996	3.4	1997	3.2	1998	3.1	1999	3.1	2000	3.1
1991	3.2	1992	3.2	1993	3.2	1994	3.1	1995	3.1	1996	3.0	1997	2.9	1998	2.8	1999	2.8	2000	2.8	2001	2.8
1992	2.8	1993	2.8	1994	2.7	1995	2.7	1996	2.6	1997	2.5	1998	2.4	1999	2.4	2000	2.4	2001	2.4	2002	2.4
1993	2.4	1994	2.3	1995	2.3	1996	2.2	1997	2.1	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0
1994	1.9	1995	1.9	1996	1.9	1997	1.7	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6	2003	1.6	2004	1.6
1995	1.4	1996	1.4	1997	1.3	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2
1996	0.9	1997	0.8	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.6	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 2.11A.1 minus the uncontrolled refueling values in Table 2.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-9. CO Emission Factors for Low Altitude LDGT1[a]

January 1 of Calendar Year																			
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	80.9	1977	80.6	1978	80.7	1979	64.5	1980	64.5	1981	44.9	1982	45.0	1983	44.9	1984	41.5	1985	7.2	1986	68.8
1977	79.6	1978	79.6	1979	63.5	1980	63.5	1981	44.3	1982	44.4	1983	44.3	1984	40.9	1985	68.2	1986	7.0	1987	64.6
1978	78.5	1979	62.5	1980	62.5	1981	43.7	1982	43.8	1983	43.7	1984	40.2	1985	66.6	1986	65.8	1987	6.7	1988	61.2
1979	61.4	1980	61.4	1981	43.0	1982	43.1	1983	43.0	1984	39.6	1985	64.9	1986	64.1	1987	61.6	1988	6.3	1989	61.9
1980	60.2	1981	42.3	1982	42.4	1983	42.3	1984	38.8	1985	63.2	1986	62.4	1987	59.9	1988	58.1	1989	5.9	1990	60.3
1981	41.6	1982	41.6	1983	41.5	1984	38.1	1985	61.4	1986	60.5	1987	58.1	1988	56.4	1989	58.5	1990	5.9	1991	58.8
1982	40.8	1983	40.8	1984	37.3	1985	59.4	1986	58.6	1987	56.2	1988	54.5	1989	56.6	1990	56.7	1991	5.7	1992	57.1
1983	39.9	1984	36.5	1985	57.3	1986	56.5	1987	54.2	1988	52.6	1989	54.6	1990	54.6	1991	54.9	1992	5.5	1993	55.1
1984	35.6	1985	55.1	1986	54.2	1987	52.1	1988	50.6	1989	52.4	1990	52.5	1991	52.7	1992	53.0	1993	5.2	1994	52.8
1985	52.7	1986	51.9	1987	49.8	1988	48.4	1989	50.1	1990	50.2	1991	50.4	1992	50.7	1993	50.7	1994	5.0	1995	50.4
1986	49.3	1987	47.4	1988	46.1	1989	47.7	1990	47.8	1991	48.0	1992	48.2	1993	48.1	1994	48.1	1995	4.6	1996	47.4
1987	44.8	1988	43.6	1989	45.1	1990	45.2	1991	45.3	1992	45.6	1993	45.6	1994	45.5	1995	45.3	1996	4.2	1997	44.3
1988	40.9	1989	42.3	1990	42.4	1991	42.6	1992	42.9	1993	42.8	1994	42.8	1995	42.6	1996	42.0	1997	3.8	1998	41.3
1989	39.4	1990	39.5	1991	39.7	1992	39.9	1993	39.8	1994	39.8	1995	39.6	1996	39.0	1997	38.6	1998	38.4	1999	38.4
1990	36.4	1991	36.6	1992	36.7	1993	36.7	1994	36.7	1995	36.5	1996	35.9	1997	35.5	1998	35.2	1999	35.2	2000	35.2
1991	33.3	1992	33.4	1993	33.4	1994	33.3	1995	33.2	1996	32.6	1997	32.2	1998	31.9	1999	31.9	2000	31.9	2001	31.9
1992	29.8	1993	29.9	1994	29.7	1995	29.6	1996	29.1	1997	28.6	1998	28.3	1999	28.3	2000	28.3	2001	28.3	2002	28.3
1993	26.1	1994	25.9	1995	25.8	1996	25.3	1997	24.8	1998	24.6	1999	24.6	2000	24.6	2001	24.6	2002	24.6	2003	24.6
1994	21.9	1995	21.8	1996	21.3	1997	20.8	1998	20.5	1999	20.5	2000	20.5	2001	20.5	2002	20.5	2003	20.5	2004	20.5
1995	17.5	1996	17.0	1997	16.5	1998	16.2	1999	16.2	2000	16.2	2001	16.2	2002	16.2	2003	16.2	2004	16.2	2005	16.2
1996	12.4	1997	12.0	1998	11.7	1999	11.7	2000	11.7	2001	11.7	2002	11.7	2003	11.7	2004	11.7	2005	11.7	2006	11.7
1997	9.2	1998	8.9	1999	8.9	2000	8.9	2001	8.9	2002	8.9	2003	8.9	2004	8.9	2005	8.9	2006	8.9	2007	8.9
1998	6.8	1999	6.8	2000	6.8	2001	6.8	2002	6.8	2003	6.8	2004	6.8	2005	6.8	2006	6.8	2007	6.8	2008	6.8
1999	4.4	2000	4.4	2001	4.4	2002	4.4	2003	4.4	2004	4.4	2005	4.4	2006	4.4	2007	4.4	2008	4.4	2009	4.4
2000	2.9	2001	2.9	2002	2.9	2003	2.9	2004	2.9	2005	2.9	2006	2.9	2007	2.9	2008	2.9	2009	2.9	2010	2.9

[a] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 2.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-10. NO_X Emission Factors for Low Altitude LDGT1[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	3.3	1977	3.3	1978	3.3	1979	2.9	1980	2.9	1981	2.2	1982	2.2	1983	2.3	1984	2.6	1985	4.9	1986	4.9
1977	3.3	1978	3.3	1979	3.0	1980	2.9	1981	2.2	1982	2.2	1983	2.3	1984	2.6	1985	4.8	1986	4.8	1987	4.9
1978	3.3	1979	2.9	1980	2.9	1981	2.2	1982	2.2	1983	2.3	1984	2.5	1985	4.7	1986	4.7	1987	4.8	1988	4.5
1979	2.9	1980	2.8	1981	2.2	1982	2.2	1983	2.2	1984	2.5	1985	4.6	1986	4.6	1987	4.7	1988	4.4	1989	4.3
1980	2.8	1981	2.2	1982	2.2	1983	2.2	1984	2.4	1985	4.5	1986	4.5	1987	4.7	1988	4.3	1989	4.2	1990	4.1
1981	2.2	1982	2.2	1983	2.2	1984	2.4	1985	4.4	1986	4.4	1987	4.5	1988	4.3	1989	4.1	1990	3.9	1991	3.9
1982	2.2	1983	2.2	1984	2.4	1985	4.3	1986	4.3	1987	4.4	1988	4.1	1989	4.0	1990	3.8	1991	3.8	1992	3.8
1983	2.2	1984	2.3	1985	4.2	1986	4.2	1987	4.2	1988	4.0	1989	3.8	1990	3.8	1991	3.7	1992	3.7	1993	3.7
1984	2.3	1985	4.0	1986	4.0	1987	4.1	1988	3.8	1989	3.7	1990	3.6	1991	3.6	1992	3.6	1993	3.5	1994	3.4
1985	3.9	1986	3.9	1987	4.0	1988	3.7	1989	3.5	1990	3.5	1991	3.4	1992	3.4	1993	3.4	1994	3.2	1995	3.1
1986	3.7	1987	3.8	1988	3.6	1989	3.4	1990	3.3	1991	3.3	1992	3.2	1993	3.3	1994	3.1	1995	3.0	1996	2.8
1987	3.6	1988	3.4	1989	3.3	1990	3.2	1991	3.2	1992	3.1	1993	3.2	1994	2.9	1995	2.8	1996	2.7	1997	2.7
1988	3.2	1989	3.1	1990	3.1	1991	3.0	1992	3.0	1993	3.0	1994	2.8	1995	2.7	1996	2.5	1997	2.5	1998	2.5
1989	2.9	1990	2.9	1991	2.8	1992	2.8	1993	2.8	1994	2.6	1995	2.5	1996	2.4	1997	2.4	1998	2.4	1999	2.4
1990	2.7	1991	2.6	1992	2.6	1993	2.6	1994	2.5	1995	2.3	1996	2.2	1997	2.2	1998	2.2	1999	2.2	2000	2.2
1991	2.4	1992	2.4	1993	2.4	1994	2.3	1995	2.1	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0
1992	2.2	1993	2.2	1994	2.0	1995	1.9	1996	1.8	1997	1.8	1998	1.8	1999	1.8	2000	1.8	2001	1.8	2002	1.8
1993	2.0	1994	1.8	1995	1.7	1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6	2003	1.6
1994	1.6	1995	1.4	1996	1.3	1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3
1995	1.2	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1
1996	0.8	1997	0.8	1998	0.8	1999	0.8	2000	0.8	2001	0.8	2002	0.8	2003	0.8	2004	0.8	2005	0.8	2006	0.8
1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7	2007	0.7
1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5	2008	0.5
1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4	2009	0.4
2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3	2010	0.3

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 2.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-11. VOC Emission Factors for High Altitude LDGT1[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	13.5	1977	11.0	1978	12.8	1979	11.0	1980	11.0	1981	8.4	1982	7.0	1983	7.0	1984	7.0	1985	8.2	1986	8.1
1977	10.7	1978	12.5	1979	10.7	1980	10.7	1981	8.2	1982	6.8	1983	6.8	1984	6.7	1985	8.0	1986	7.7	1987	7.5
1978	12.2	1979	10.4	1980	10.4	1981	8.0	1982	6.6	1983	6.6	1984	6.6	1985	7.7	1986	7.5	1987	7.2	1988	7.1
1979	10.1	1980	10.1	1981	7.8	1982	6.4	1983	6.4	1984	6.4	1985	7.4	1986	7.2	1987	7.0	1988	6.8	1989	7.0
1980	9.7	1981	7.6	1982	6.2	1983	6.2	1984	6.2	1985	7.2	1986	6.9	1987	6.8	1988	6.6	1989	6.7	1990	6.8
1981	7.4	1982	6.0	1983	6.0	1984	6.0	1985	6.9	1986	6.7	1987	6.5	1988	6.3	1989	6.5	1990	6.5	1991	6.5
1982	5.8	1983	5.7	1984	5.8	1985	6.6	1986	6.5	1987	6.3	1988	6.1	1989	6.2	1990	6.3	1991	6.2	1992	6.3
1983	5.5	1984	5.6	1985	6.3	1986	6.2	1987	6.0	1988	5.8	1989	6.0	1990	5.9	1991	6.0	1992	6.1	1993	6.0
1984	5.4	1985	6.0	1986	5.9	1987	5.7	1988	5.6	1989	5.7	1990	5.7	1991	5.7	1992	5.8	1993	5.8	1994	5.5
1985	5.7	1986	5.6	1987	5.4	1988	5.3	1989	5.4	1990	5.4	1991	5.4	1992	5.4	1993	5.5	1994	5.3	1995	5.2
1986	5.3	1987	5.1	1988	5.0	1989	5.1	1990	5.1	1991	5.1	1992	5.1	1993	5.1	1994	5.0	1995	4.8	1996	4.7
1987	4.8	1988	4.7	1989	4.8	1990	4.8	1991	4.8	1992	4.8	1993	4.8	1994	4.6	1995	4.5	1996	4.4	1997	4.3
1988	4.3	1989	4.5	1990	4.5	1991	4.5	1992	4.6	1993	4.5	1994	4.3	1995	4.2	1996	4.1	1997	4.0	1998	3.9
1989	4.1	1990	4.2	1991	4.2	1992	4.2	1993	4.2	1994	4.0	1995	3.8	1996	3.6	1997	3.7	1998	3.5	1999	3.5
1990	3.8	1991	3.8	1992	3.8	1993	3.8	1994	3.6	1995	3.5	1996	3.3	1997	3.3	1998	3.2	1999	3.2	2000	3.2
1991	3.4	1992	3.4	1993	3.4	1994	3.2	1995	3.2	1996	3.0	1997	3.0	1998	2.8	1999	2.8	2000	2.8	2001	2.8
1992	3.0	1993	3.0	1994	2.8	1995	2.8	1996	2.7	1997	2.6	1998	2.5	1999	2.5	2000	2.5	2001	2.5	2002	2.5
1993	2.6	1994	2.4	1995	2.4	1996	2.3	1997	2.2	1998	2.1	1999	2.1	2000	2.1	2001	2.1	2002	2.1	2003	2.1
1994	2.0	1995	2.0	1996	1.7	1997	1.8	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6	2003	1.6	2004	1.6
1995	1.5	1996	1.3	1997	1.4	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2
1996	0.9	1997	0.9	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.6	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 2.11A.2 minus the uncontrolled refueling values in Table 2.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-12. CO Emission Factors for High Altitude LDGT1[a]

January 1 of Calendar Year																				
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	116.7	1977	78.8	1978	111.5	1979	98.8	1980	98.8	1981	84.6	1982	64.0	1983	64.0	1984	56.6	1985	7.2	1986	70.8
1977	77.8	1978	110.5	1979	97.8	1980	97.8	1981	84.0	1982	63.4	1983	63.4	1984	56.0	1985	70.4	1986	7.0	1987	66.5
1978	109.4	1979	96.7	1980	96.8	1981	83.4	1982	62.7	1983	62.8	1984	55.4	1985	68.9	1986	67.8	1987	6.7	1988	63.0
1979	95.6	1980	95.7	1981	82.7	1982	62.1	1983	62.1	1984	54.7	1985	67.2	1986	66.2	1987	63.4	1988	6.3	1989	63.7
1980	94.5	1981	82.0	1982	61.4	1983	61.4	1984	54.1	1985	65.5	1986	64.5	1987	61.8	1988	59.9	1989	5.9	1990	62.0
1981	81.2	1982	60.7	1983	60.6	1984	53.3	1985	63.6	1986	62.6	1987	60.0	1988	58.2	1989	60.2	1990	5.9	1991	60.4
1982	59.9	1983	59.9	1984	52.5	1985	61.6	1986	60.6	1987	58.1	1988	56.3	1989	58.3	1990	58.3	1991	5.7	1992	58.8
1983	59.0	1984	51.6	1985	59.5	1986	58.5	1987	56.1	1988	54.4	1989	56.3	1990	56.3	1991	56.5	1992	5.5	1993	56.8
1984	50.7	1985	57.3	1986	56.2	1987	54.0	1988	52.3	1989	54.1	1990	54.2	1991	54.3	1992	54.6	1993	5.2	1994	52.8
1985	54.9	1986	53.9	1987	51.7	1988	50.1	1989	51.8	1990	51.9	1991	52.0	1992	52.3	1993	52.3	1994	5.0	1995	50.4
1986	51.3	1987	49.3	1988	47.8	1989	49.4	1990	49.5	1991	49.6	1992	49.9	1993	49.9	1994	48.1	1995	4.6	1996	47.4
1987	46.7	1988	45.3	1989	46.8	1990	46.9	1991	47.1	1992	47.3	1993	47.3	1994	45.5	1995	45.3	1996	4.2	1997	44.3
1988	42.6	1989	44.0	1990	44.1	1991	44.3	1992	44.4	1993	44.5	1994	42.8	1995	42.6	1996	42.0	1997	3.8	1998	41.3
1989	41.1	1990	41.2	1991	41.4	1992	41.5	1993	41.5	1994	39.8	1995	39.6	1996	39.0	1997	38.6	1998	38.4	1999	38.4
1990	38.1	1991	38.2	1992	38.4	1993	38.4	1994	36.7	1995	36.5	1996	35.9	1997	35.5	1998	35.2	1999	35.2	2000	35.2
1991	34.9	1992	35.0	1993	35.1	1994	33.3	1995	33.2	1996	32.6	1997	32.2	1998	31.9	1999	31.9	2000	31.9	2001	31.9
1992	31.5	1993	31.5	1994	29.7	1995	29.6	1996	29.1	1997	28.6	1998	28.3	1999	28.3	2000	28.3	2001	28.3	2002	28.3
1993	27.7	1994	25.9	1995	25.8	1996	25.3	1997	24.8	1998	24.6	1999	24.6	2000	24.6	2001	24.6	2002	24.6	2003	24.6
1994	21.9	1995	21.8	1996	21.3	1997	20.8	1998	20.5	1999	20.5	2000	20.5	2001	20.5	2002	20.5	2003	20.5	2004	20.5
1995	17.5	1996	17.0	1997	16.5	1998	16.2	1999	16.2	2000	16.2	2001	16.2	2002	16.2	2003	16.2	2004	16.2	2005	16.2
1996	12.4	1997	12.0	1998	11.7	1999	11.7	2000	11.7	2001	11.7	2002	11.7	2003	11.7	2004	11.7	2005	11.7	2006	11.7
1997	9.2	1998	8.9	1999	8.9	2000	8.9	2001	8.9	2002	8.9	2003	8.9	2004	8.9	2005	8.9	2006	8.9	2007	8.9
1998	6.8	1999	6.8	2000	6.8	2001	6.8	2002	6.8	2003	6.8	2004	6.8	2005	6.8	2006	6.8	2007	6.8	2008	6.8
1999	4.4	2000	4.4	2001	4.4	2002	4.4	2003	4.4	2004	4.4	2005	4.4	2006	4.4	2007	4.4	2008	4.4	2009	4.4
2000	2.9	2001	2.9	2002	2.9	2003	2.9	2004	2.9	2005	2.9	2006	2.9	2007	2.9	2008	2.9	2009	2.9	2010	2.9

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 2.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-13. NO_X Emission Factors for High Altitude LDGT1[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	2.5	1977	2.8	1978	2.4	1979	2.1	1980	2.1	1981	1.7	1982	2.0	1983	2.1	1984	2.7	1985	4.9	1986	4.9
1977	2.8	1978	2.4	1979	2.2	1980	2.1	1981	1.7	1982	2.0	1983	2.1	1984	2.7	1985	4.8	1986	4.8	1987	4.9
1978	2.4	1979	2.1	1980	2.1	1981	1.7	1982	2.0	1983	2.1	1984	2.6	1985	4.7	1986	4.7	1987	4.8	1988	4.5
1979	2.1	1980	2.0	1981	1.6	1982	2.0	1983	2.0	1984	2.6	1985	4.6	1986	4.6	1987	4.7	1988	4.4	1989	4.3
1980	2.0	1981	1.6	1982	2.0	1983	2.0	1984	2.5	1985	4.5	1986	4.5	1987	4.7	1988	4.3	1989	4.2	1990	4.1
1981	1.6	1982	2.0	1983	2.0	1984	2.5	1985	4.4	1986	4.4	1987	4.5	1988	4.3	1989	4.1	1990	3.9	1991	3.9
1982	2.0	1983	2.0	1984	2.5	1985	4.3	1986	4.3	1987	4.4	1988	4.1	1989	4.0	1990	3.8	1991	3.8	1992	3.8
1983	2.0	1984	2.4	1985	4.2	1986	4.2	1987	4.2	1988	4.0	1989	3.8	1990	3.8	1991	3.7	1992	3.7	1993	3.7
1984	2.4	1985	4.0	1986	4.0	1987	4.1	1988	3.8	1989	3.7	1990	3.6	1991	3.6	1992	3.6	1993	3.5	1994	3.4
1985	3.9	1986	3.9	1987	4.0	1988	3.7	1989	3.5	1990	3.5	1991	3.4	1992	3.4	1993	3.4	1994	3.2	1995	3.1
1986	3.7	1987	3.8	1988	3.6	1989	3.4	1990	3.3	1991	3.3	1992	3.2	1993	3.3	1994	3.1	1995	3.0	1996	2.8
1987	3.6	1988	3.4	1989	3.3	1990	3.2	1991	3.2	1992	3.1	1993	3.2	1994	2.9	1995	2.8	1996	2.7	1997	2.7
1988	3.2	1989	3.1	1990	3.1	1991	3.0	1992	3.0	1993	3.0	1994	2.8	1995	2.7	1996	2.5	1997	2.5	1998	2.5
1989	2.9	1990	2.9	1991	2.8	1992	2.8	1993	2.8	1994	2.6	1995	2.5	1996	2.4	1997	2.4	1998	2.4	1999	2.4
1990	2.7	1991	2.6	1992	2.6	1993	2.6	1994	2.5	1995	2.3	1996	2.2	1997	2.2	1998	2.2	1999	2.2	2000	2.2
1991	2.4	1992	2.4	1993	2.4	1994	2.3	1995	2.1	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0
1992	2.2	1993	2.2	1994	2.0	1995	1.9	1996	1.8	1997	1.8	1998	1.8	1999	1.8	2000	1.8	2001	1.8	2002	1.8
1993	2.0	1994	1.8	1995	1.7	1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6	2003	1.6
1994	1.6	1995	1.4	1996	1.3	1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3
1995	1.2	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1
1996	0.8	1997	0.8	1998	0.8	1999	0.8	2000	0.8	2001	0.8	2002	0.8	2003	0.8	2004	0.8	2005	0.8	2006	0.8
1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7	2007	0.7
1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5	2008	0.5
1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4	2009	0.4
2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3	2010	0.3

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 2.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-14. VOC Emission Factors for Low Altitude LDGT2[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	14.6	1977	14.6	1978	14.6	1979	10.7	1980	10.7	1981	6.8	1982	6.8	1983	6.7	1984	6.7	1985	8.8	1986	8.7
1977	14.4	1978	14.4	1979	10.4	1980	10.4	1981	6.6	1982	6.6	1983	6.6	1984	6.5	1985	8.5	1986	8.4	1987	8.1
1978	14.2	1979	10.0	1980	10.1	1981	6.4	1982	6.4	1983	6.4	1984	6.3	1985	8.2	1986	8.1	1987	7.8	1988	7.6
1979	9.7	1980	9.7	1981	6.2	1982	6.2	1983	6.2	1984	6.1	1985	7.9	1986	7.8	1987	7.5	1988	7.4	1989	7.6
1980	9.4	1981	6.0	1982	6.0	1983	6.0	1984	5.9	1985	7.6	1986	7.5	1987	7.2	1988	7.1	1989	7.3	1990	7.3
1981	5.8	1982	5.8	1983	5.8	1984	5.7	1985	7.3	1986	7.2	1987	6.9	1988	6.7	1989	7.0	1990	7.0	1991	7.0
1982	5.6	1983	5.6	1984	5.5	1985	7.0	1986	6.8	1987	6.6	1988	6.4	1989	6.6	1990	6.7	1991	6.7	1992	6.8
1983	5.4	1984	5.2	1985	6.6	1986	6.5	1987	6.3	1988	6.1	1989	6.3	1990	6.4	1991	6.4	1992	6.4	1993	6.4
1984	5.0	1985	6.3	1986	6.1	1987	6.0	1988	5.8	1989	6.0	1990	6.0	1991	6.1	1992	6.1	1993	6.0	1994	6.0
1985	5.9	1986	5.8	1987	5.6	1988	5.5	1989	5.6	1990	5.7	1991	5.7	1992	5.7	1993	5.7	1994	5.6	1995	5.6
1986	5.4	1987	5.3	1988	5.1	1989	5.3	1990	5.4	1991	5.4	1992	5.4	1993	5.3	1994	5.3	1995	5.3	1996	5.2
1987	4.9	1988	4.8	1989	4.9	1990	5.0	1991	5.0	1992	5.0	1993	5.0	1994	4.9	1995	4.9	1996	4.7	1997	4.7
1988	4.4	1989	4.6	1990	4.6	1991	4.6	1992	4.6	1993	4.6	1994	4.6	1995	4.5	1996	4.4	1997	4.4	1998	4.2
1989	4.2	1990	4.2	1991	4.2	1992	4.2	1993	4.2	1994	4.2	1995	4.1	1996	3.9	1997	4.0	1998	3.8	1999	3.8
1990	3.8	1991	3.8	1992	3.8	1993	3.8	1994	3.7	1995	3.7	1996	3.6	1997	3.5	1998	3.4	1999	3.4	2000	3.4
1991	3.4	1992	3.3	1993	3.4	1994	3.3	1995	3.3	1996	3.2	1997	3.1	1998	3.1	1999	3.0	2000	3.0	2001	3.0
1992	2.9	1993	2.9	1994	2.9	1995	2.9	1996	2.8	1997	2.7	1998	2.7	1999	2.6	2000	2.6	2001	2.6	2002	2.6
1993	2.5	1994	2.4	1995	2.4	1996	2.4	1997	2.3	1998	2.2	1999	2.1	2000	2.1	2001	2.1	2002	2.1	2003	2.1
1994	2.0	1995	2.0	1996	1.8	1997	1.8	1998	1.7	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7	2004	1.7
1995	1.5	1996	1.4	1997	1.3	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2
1996	0.9	1997	0.8	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.7	1998	0.6	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5
1998	0.5	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.2	2001	0.2	2002	0.2	2003	0.2	2004	0.2	2005	0.2	2006	0.2	2007	0.2	2008	0.2	2009	0.2	2010	0.2

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 3.11A.1 minus the uncontrolled refueling values in Table 3.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-15. CO Emission Factors for Low Altitude LDGT2[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	118.8	1977	118.8	1978	118.9	1979	77.0	1980	77.0	1981	51.8	1982	51.8	1983	51.8	1984	48.4	1985	86.3	1986	85.6
1977	117.2	1978	117.3	1979	75.3	1980	75.3	1981	50.8	1982	50.8	1983	50.8	1984	47.4	1985	83.8	1986	83.0	1987	79.6
1978	115.6	1979	73.5	1980	73.5	1981	49.7	1982	49.7	1983	49.7	1984	46.3	1985	81.2	1986	80.4	1987	77.1	1988	74.7
1979	71.7	1980	71.6	1981	48.6	1982	48.6	1983	48.5	1984	45.2	1985	78.5	1986	77.7	1987	74.5	1988	72.2	1989	75.0
1980	69.7	1981	47.4	1982	47.4	1983	47.4	1984	44.0	1985	75.7	1986	74.8	1987	71.8	1988	69.6	1989	72.2	1990	72.3
1981	46.2	1982	46.2	1983	46.2	1984	42.8	1985	72.7	1986	71.9	1987	69.0	1988	66.9	1989	69.4	1990	69.5	1991	69.7
1982	45.0	1983	45.0	1984	41.6	1985	69.7	1986	69.0	1987	66.1	1988	64.1	1989	66.6	1990	66.6	1991	66.8	1992	67.1
1983	43.7	1984	40.3	1985	66.6	1986	65.8	1987	63.1	1988	61.2	1989	63.5	1990	63.6	1991	63.8	1992	64.0	1993	64.1
1984	39.0	1985	63.3	1986	62.5	1987	60.0	1988	58.2	1989	60.4	1990	60.4	1991	60.7	1992	60.9	1993	60.9	1994	60.9
1985	60.0	1986	59.1	1987	56.8	1988	55.1	1989	57.2	1990	57.2	1991	57.4	1992	57.7	1993	57.7	1994	57.7	1995	57.7
1986	55.6	1987	53.5	1988	51.9	1989	53.8	1990	53.9	1991	54.1	1992	54.3	1993	54.3	1994	54.3	1995	54.3	1996	54.2
1987	50.0	1988	48.6	1989	50.3	1990	50.4	1991	50.6	1992	50.8	1993	50.8	1994	50.8	1995	50.8	1996	50.7	1997	50.6
1988	45.1	1989	46.7	1990	46.8	1991	47.0	1992	47.2	1993	47.2	1994	47.2	1995	47.2	1996	47.1	1997	46.9	1998	46.6
1989	42.9	1990	43.1	1991	43.3	1992	43.4	1993	43.4	1994	43.4	1995	43.4	1996	43.3	1997	43.2	1998	42.8	1999	42.5
1990	39.2	1991	39.4	1992	39.5	1993	39.5	1994	39.5	1995	39.5	1996	39.4	1997	39.3	1998	38.9	1999	38.6	2000	38.6
1991	35.4	1992	35.5	1993	35.5	1994	35.5	1995	35.5	1996	35.4	1997	35.3	1998	35.0	1999	34.5	2000	34.5	2001	34.5
1992	31.3	1993	31.3	1994	31.3	1995	31.3	1996	31.2	1997	31.1	1998	30.8	1999	30.4	2000	30.4	2001	30.4	2002	30.4
1993	27.0	1994	27.0	1995	27.0	1996	26.9	1997	26.8	1998	26.4	1999	26.0	2000	26.0	2001	26.0	2002	26.0	2003	26.0
1994	22.5	1995	22.5	1996	22.4	1997	22.3	1998	21.9	1999	21.5	2000	21.5	2001	21.5	2002	21.5	2003	21.5	2004	21.5
1995	17.8	1996	17.7	1997	17.7	1998	17.2	1999	16.9	2000	16.9	2001	16.9	2002	16.9	2003	16.9	2004	16.9	2005	16.9
1996	12.9	1997	12.8	1998	12.3	1999	12.1	2000	12.1	2001	12.1	2002	12.1	2003	12.1	2004	12.1	2005	12.1	2006	12.1
1997	10.1	1998	9.7	1999	9.4	2000	9.4	2001	9.4	2002	9.4	2003	9.4	2004	9.4	2005	9.4	2006	9.4	2007	9.4
1998	7.5	1999	7.2	2000	7.2	2001	7.2	2002	7.2	2003	7.2	2004	7.2	2005	7.2	2006	7.2	2007	7.2	2008	7.2
1999	4.9	2000	4.9	2001	4.9	2002	4.9	2003	4.9	2004	4.9	2005	4.9	2006	4.9	2007	4.9	2008	4.9	2009	4.9
2000	3.5	2001	3.5	2002	3.5	2003	3.5	2004	3.5	2005	3.5	2006	3.5	2007	3.5	2008	3.5	2009	3.5	2010	3.5

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 3.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-16. NO_X Emission Factors for Low Altitude LDGT2[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	5.6	1977	5.5	1978	5.6	1979	3.2	1980	3.3	1981	2.3	1982	2.3	1983	2.3	1984	2.9	1985	5.8	1986	5.9
1977	5.5	1978	5.5	1979	3.2	1980	3.2	1981	2.3	1982	2.3	1983	2.3	1984	2.8	1985	5.7	1986	5.8	1987	5.9
1978	5.5	1979	3.2	1980	3.2	1981	2.3	1982	2.3	1983	2.3	1984	2.7	1985	5.5	1986	5.6	1987	5.7	1988	5.3
1979	3.1	1980	3.1	1981	2.2	1982	2.3	1983	2.3	1984	2.7	1985	5.4	1986	5.5	1987	5.5	1988	5.2	1989	5.0
1980	3.0	1981	2.2	1982	2.2	1983	2.3	1984	2.6	1985	5.2	1986	5.3	1987	5.4	1988	5.0	1989	4.9	1990	4.7
1981	2.2	1982	2.2	1983	2.2	1984	2.6	1985	5.1	1986	5.1	1987	5.2	1988	4.9	1989	4.7	1990	4.6	1991	4.5
1982	2.2	1983	2.2	1984	2.6	1985	4.9	1986	4.9	1987	5.0	1988	4.7	1989	4.6	1990	4.4	1991	4.4	1992	4.3
1983	2.2	1984	2.5	1985	4.7	1986	4.7	1987	4.8	1988	4.5	1989	4.4	1990	4.2	1991	4.2	1992	4.2	1993	4.1
1984	2.5	1985	4.5	1986	4.5	1987	4.6	1988	4.3	1989	4.2	1990	4.0	1991	4.0	1992	4.0	1993	4.0	1994	4.0
1985	4.3	1986	4.3	1987	4.4	1988	4.1	1989	4.0	1990	3.8	1991	3.8	1992	3.8	1993	3.8	1994	3.8	1995	3.8
1986	4.1	1987	4.1	1988	3.9	1989	3.8	1990	3.6	1991	3.6	1992	3.6	1993	3.6	1994	3.6	1995	3.6	1996	3.5
1987	3.9	1988	3.6	1989	3.6	1990	3.4	1991	3.4	1992	3.4	1993	3.4	1994	3.4	1995	3.4	1996	3.3	1997	3.2
1988	3.4	1989	3.3	1990	3.2	1991	3.2	1992	3.2	1993	3.2	1994	3.2	1995	3.1	1996	3.1	1997	3.0	1998	2.9
1989	3.1	1990	3.0	1991	3.0	1992	3.0	1993	2.9	1994	3.0	1995	2.9	1996	2.8	1997	2.8	1998	2.7	1999	2.7
1990	2.8	1991	2.7	1992	2.8	1993	2.7	1994	2.7	1995	2.7	1996	2.6	1997	2.6	1998	2.5	1999	2.5	2000	2.5
1991	2.5	1992	2.5	1993	2.5	1994	2.5	1995	2.5	1996	2.4	1997	2.3	1998	2.3	1999	2.2	2000	2.2	2001	2.2
1992	2.3	1993	2.3	1994	2.3	1995	2.3	1996	2.1	1997	2.1	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0
1993	2.0	1994	2.1	1995	2.0	1996	1.9	1997	1.9	1998	1.8	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7
1994	1.8	1995	1.8	1996	1.7	1997	1.6	1998	1.6	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5
1995	1.5	1996	1.5	1997	1.3	1998	1.3	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2
1996	1.2	1997	1.1	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0
1997	0.9	1998	0.8	1999	0.8	2000	0.8	2001	0.8	2002	0.8	2003	0.8	2004	0.8	2005	0.8	2006	0.8	2007	0.8
1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7	2007	0.7	2008	0.7
1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5	2008	0.5	2009	0.5
2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4	2009	0.4	2010	0.4

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 3.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-17. VOC Emission Factors for High Altitude LDGT2[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	17.7	1977	17.7	1978	17.7	1979	11.7	1980	11.7	1981	8.7	1982	7.2	1983	7.2	1984	7.3	1985	9.2	1986	9.0
1977	17.5	1978	17.5	1979	11.4	1980	11.4	1981	8.5	1982	7.0	1983	7.0	1984	7.0	1985	8.9	1986	8.7	1987	8.5
1978	17.3	1979	11.1	1980	11.1	1981	8.3	1982	6.8	1983	6.8	1984	6.9	1985	8.6	1986	8.4	1987	8.2	1988	7.9
1979	10.8	1980	10.7	1981	8.1	1982	6.6	1983	6.6	1984	6.7	1985	8.3	1986	8.1	1987	7.9	1988	7.7	1989	7.9
1980	10.4	1981	7.8	1982	6.4	1983	6.4	1984	6.4	1985	8.0	1986	7.8	1987	7.5	1988	7.4	1989	7.6	1990	7.6
1981	7.6	1982	6.2	1983	6.2	1984	6.2	1985	7.6	1986	7.5	1987	7.2	1988	7.0	1989	7.3	1990	7.3	1991	7.3
1982	6.0	1983	5.9	1984	6.0	1985	7.3	1986	7.1	1987	6.9	1988	6.7	1989	6.8	1990	7.0	1991	6.9	1992	7.0
1983	5.7	1984	5.8	1985	6.9	1986	6.8	1987	6.5	1988	6.4	1989	6.5	1990	6.6	1991	6.6	1992	6.6	1993	6.7
1984	5.6	1985	6.6	1986	6.4	1987	6.2	1988	6.0	1989	6.2	1990	6.2	1991	6.3	1992	6.3	1993	6.3	1994	6.2
1985	6.2	1986	6.1	1987	5.8	1988	5.7	1989	5.8	1990	5.9	1991	5.9	1992	5.9	1993	6.0	1994	5.7	1995	5.7
1986	5.7	1987	5.5	1988	5.3	1989	5.5	1990	5.6	1991	5.6	1992	5.6	1993	5.5	1994	5.4	1995	5.4	1996	5.3
1987	5.1	1988	5.0	1989	5.1	1990	5.2	1991	5.2	1992	5.2	1993	5.2	1994	5.0	1995	5.0	1996	4.9	1997	4.8
1988	4.6	1989	4.8	1990	4.8	1991	4.8	1992	4.8	1993	4.8	1994	4.7	1995	4.6	1996	4.5	1997	4.4	1998	4.3
1989	4.4	1990	4.4	1991	4.4	1992	4.4	1993	4.4	1994	4.3	1995	4.2	1996	4.1	1997	4.0	1998	3.9	1999	3.9
1990	4.0	1991	4.0	1992	4.0	1993	4.0	1994	3.8	1995	3.8	1996	3.7	1997	3.6	1998	3.5	1999	3.5	2000	3.5
1991	3.6	1992	3.5	1993	3.6	1994	3.4	1995	3.4	1996	3.3	1997	3.2	1998	3.0	1999	3.0	2000	3.0	2001	3.0
1992	3.1	1993	3.1	1994	3.0	1995	3.0	1996	2.9	1997	2.8	1998	2.6	1999	2.6	2000	2.6	2001	2.6	2002	2.6
1993	2.7	1994	2.5	1995	2.5	1996	2.4	1997	2.4	1998	2.2	1999	2.2	2000	2.2	2001	2.2	2002	2.2	2003	2.2
1994	2.1	1995	2.1	1996	2.0	1997	1.9	1998	1.8	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7	2004	1.7
1995	1.6	1996	1.5	1997	1.4	1998	1.3	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2
1996	1.0	1997	0.9	1998	0.8	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.7	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6
1998	0.5	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3	2010	0.3

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 3.11A.2 minus the uncontrolled refueling values in Table 3.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-18. CO Emission Factors for High Altitude LDGT2[a]

January 1 of Calendar Year																			
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	166.5	1977	166.5	1978	166.4	1979	111.9	1980	111.8	1981	91.5	1982	70.9	1983	70.9	1984	63.5	1985	88.5	1986	87.6
1977	164.9	1978	164.8	1979	110.2	1980	110.1	1981	90.5	1982	69.9	1983	69.9	1984	62.5	1985	86.0	1986	85.0	1987	81.5
1978	163.2	1979	108.4	1980	108.3	1981	89.4	1982	68.8	1983	68.8	1984	61.4	1985	83.4	1986	82.4	1987	79.0	1988	76.5
1979	106.5	1980	106.4	1981	88.3	1982	67.7	1983	67.6	1984	60.3	1985	80.7	1986	79.7	1987	76.4	1988	74.0	1989	76.7
1980	104.5	1981	87.1	1982	66.5	1983	66.5	1984	59.1	1985	77.9	1986	76.9	1987	73.7	1988	71.4	1989	74.0	1990	73.9
1981	85.9	1982	65.3	1983	65.3	1984	57.9	1985	74.9	1986	74.0	1987	70.9	1988	68.7	1989	71.2	1990	71.1	1991	71.4
1982	64.1	1983	64.1	1984	56.7	1985	71.9	1986	70.9	1987	68.0	1988	65.9	1989	68.3	1990	68.2	1991	68.5	1992	68.8
1983	62.8	1984	55.4	1985	68.8	1986	67.8	1987	65.0	1988	63.0	1989	65.2	1990	65.3	1991	65.5	1992	65.7	1993	65.7
1984	54.1	1985	65.5	1986	64.6	1987	61.9	1988	59.9	1989	62.1	1990	62.1	1991	62.3	1992	62.6	1993	62.6	1994	60.9
1985	62.2	1986	61.2	1987	58.7	1988	56.8	1989	58.9	1990	58.9	1991	59.0	1992	59.4	1993	59.3	1994	57.7	1995	57.7
1986	57.7	1987	55.3	1988	53.6	1989	55.5	1990	55.6	1991	55.7	1992	56.0	1993	55.9	1994	54.3	1995	54.3	1996	54.2
1987	51.8	1988	50.3	1989	52.0	1990	52.1	1991	52.2	1992	52.5	1993	52.4	1994	50.8	1995	50.8	1996	50.7	1997	50.6
1988	46.8	1989	48.4	1990	48.5	1991	48.6	1992	48.9	1993	48.8	1994	47.2	1995	47.2	1996	47.1	1997	46.9	1998	46.6
1989	44.6	1990	44.8	1991	44.9	1992	45.1	1993	45.1	1994	43.4	1995	43.4	1996	43.3	1997	43.2	1998	42.8	1999	42.5
1990	40.9	1991	41.0	1992	41.2	1993	41.2	1994	39.5	1995	39.5	1996	39.4	1997	39.3	1998	38.9	1999	38.6	2000	38.6
1991	37.0	1992	37.2	1993	37.1	1994	35.5	1995	35.5	1996	35.4	1997	35.3	1998	35.0	1999	34.5	2000	34.5	2001	34.5
1992	33.0	1993	33.0	1994	31.3	1995	31.3	1996	31.2	1997	31.1	1998	30.8	1999	30.4	2000	30.4	2001	30.4	2002	30.4
1993	28.6	1994	27.0	1995	27.0	1996	26.9	1997	26.8	1998	26.4	1999	26.0	2000	26.0	2001	26.0	2002	26.0	2003	26.0
1994	22.5	1995	22.5	1996	22.4	1997	22.3	1998	21.9	1999	21.5	2000	21.5	2001	21.5	2002	21.5	2003	21.5	2004	21.5
1995	17.8	1996	17.7	1997	17.7	1998	17.2	1999	16.9	2000	16.9	2001	16.9	2002	16.9	2003	16.9	2004	16.9	2005	16.9
1996	12.9	1997	12.8	1998	12.3	1999	12.1	2000	12.1	2001	12.1	2002	12.1	2003	12.1	2004	12.1	2005	12.1	2006	12.1
1997	10.1	1998	9.7	1999	9.4	2000	9.4	2001	9.4	2002	9.4	2003	9.4	2004	9.4	2005	9.4	2006	9.4	2007	9.4
1998	7.5	1999	7.2	2000	7.2	2001	7.2	2002	7.2	2003	7.2	2004	7.2	2005	7.2	2006	7.2	2007	7.2	2008	7.2
1999	4.9	2000	4.9	2001	4.9	2002	4.9	2003	4.9	2004	4.9	2005	4.9	2006	4.9	2007	4.9	2008	4.9	2009	4.9
2000	3.5	2001	3.5	2002	3.5	2003	3.5	2004	3.5	2005	3.5	2006	3.5	2007	3.5	2008	3.5	2009	3.5	2010	3.5

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 3.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-19. NO_X Emission Factors for High Altitude LDGT2[a]

January 1 of Calendar Year																			
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	4.0	1977	4.0	1978	4.1	1979	2.4	1980	2.5	1981	1.8	1982	2.1	1983	2.1	1984	3.0	1985	5.8	1986	5.9
1977	4.0	1978	4.0	1979	2.4	1980	2.4	1981	1.8	1982	2.1	1983	2.1	1984	2.9	1985	5.7	1986	5.8	1987	5.9
1978	4.0	1979	2.4	1980	2.4	1981	1.8	1982	2.1	1983	2.1	1984	2.8	1985	5.5	1986	5.6	1987	5.7	1988	5.3
1979	2.3	1980	2.3	1981	1.7	1982	2.1	1983	2.1	1984	2.8	1985	5.4	1986	5.5	1987	5.5	1988	5.2	1989	5.0
1980	2.2	1981	1.7	1982	2.0	1983	2.1	1984	2.7	1985	5.2	1986	5.3	1987	5.4	1988	5.0	1989	4.9	1990	4.7
1981	1.7	1982	2.0	1983	2.0	1984	2.7	1985	5.1	1986	5.1	1987	5.2	1988	4.9	1989	4.7	1990	4.6	1991	4.5
1982	2.0	1983	2.0	1984	2.7	1985	4.9	1986	4.9	1987	5.0	1988	4.7	1989	4.6	1990	4.4	1991	4.4	1992	4.3
1983	2.0	1984	2.6	1985	4.7	1986	4.7	1987	4.8	1988	4.5	1989	4.4	1990	4.2	1991	4.2	1992	4.2	1993	4.1
1984	2.6	1985	4.5	1986	4.5	1987	4.6	1988	4.3	1989	4.2	1990	4.0	1991	4.0	1992	4.0	1993	4.0	1994	4.0
1985	4.3	1986	4.3	1987	4.4	1988	4.1	1989	4.0	1990	3.8	1991	3.8	1992	3.8	1993	3.8	1994	3.8	1995	3.8
1986	4.1	1987	4.1	1988	3.9	1989	3.8	1990	3.6	1991	3.6	1992	3.6	1993	3.6	1994	3.6	1995	3.6	1996	3.5
1987	3.9	1988	3.6	1989	3.6	1990	3.4	1991	3.4	1992	3.4	1993	3.4	1994	3.4	1995	3.4	1996	3.3	1997	3.2
1988	3.4	1989	3.3	1990	3.2	1991	3.2	1992	3.2	1993	3.2	1994	3.2	1995	3.1	1996	3.1	1997	3.0	1998	2.9
1989	3.1	1990	3.0	1991	3.0	1992	3.0	1993	2.9	1994	3.0	1995	2.9	1996	2.8	1997	2.8	1998	2.7	1999	2.7
1990	2.8	1991	2.7	1992	2.8	1993	2.7	1994	2.7	1995	2.7	1996	2.6	1997	2.6	1998	2.5	1999	2.5	2000	2.5
1991	2.5	1992	2.5	1993	2.5	1994	2.5	1995	2.5	1996	2.4	1997	2.3	1998	2.3	1999	2.2	2000	2.2	2001	2.2
1992	2.3	1993	2.3	1994	2.3	1995	2.3	1996	2.1	1997	2.1	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0
1993	2.0	1994	2.1	1995	2.0	1996	1.9	1997	1.9	1998	1.8	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7
1994	1.8	1995	1.8	1996	1.7	1997	1.6	1998	1.6	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5
1995	1.5	1996	1.5	1997	1.3	1998	1.3	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2
1996	1.2	1997	1.1	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0
1997	0.9	1998	0.8	1999	0.8	2000	0.8	2001	0.8	2002	0.8	2003	0.8	2004	0.8	2005	0.8	2006	0.8	2007	0.8
1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7	2007	0.7	2008	0.7
1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5	2008	0.5	2009	0.5
2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4	2009	0.4	2010	0.4

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 3.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-20. VOC Emission Factors for Low Altitude HDGV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	17.7	1977	15.9	1978	15.9	1979	12.4	1980	12.0	1981	11.5	1982	11.6	1983	11.5	1984	11.6	1985	5.4	1986	5.1
1977	15.8	1978	15.8	1979	12.3	1980	11.9	1981	11.5	1982	11.5	1983	11.5	1984	11.4	1985	5.3	1986	5.1	1987	4.9
1978	15.7	1979	12.2	1980	11.8	1981	11.4	1982	11.4	1983	11.4	1984	11.4	1985	5.2	1986	5.0	1987	4.9	1988	4.9
1979	12.1	1980	11.7	1981	11.3	1982	11.3	1983	11.3	1984	11.3	1985	5.2	1986	4.9	1987	4.8	1988	4.8	1989	4.8
1980	11.6	1981	11.2	1982	11.2	1983	11.2	1984	11.2	1985	5.1	1986	4.8	1987	4.6	1988	4.7	1989	4.7	1990	4.8
1981	11.1	1982	11.2	1983	11.1	1984	11.1	1985	5.0	1986	4.7	1987	4.5	1988	4.6	1989	4.6	1990	4.6	1991	4.7
1982	11.1	1983	11.1	1984	11.0	1985	4.9	1986	4.7	1987	4.4	1988	4.5	1989	4.4	1990	4.5	1991	4.5	1992	4.5
1983	11.0	1984	10.9	1985	4.8	1986	4.6	1987	4.3	1988	4.4	1989	4.3	1990	4.4	1991	4.4	1992	4.4	1993	4.4
1984	10.8	1985	4.7	1986	4.5	1987	4.2	1988	4.2	1989	4.2	1990	4.3	1991	4.3	1992	4.3	1993	4.3	1994	4.3
1985	4.6	1986	4.3	1987	4.1	1988	4.1	1989	4.0	1990	4.2	1991	4.2	1992	4.1	1993	4.2	1994	4.1	1995	4.2
1986	4.2	1987	3.9	1988	3.9	1989	3.9	1990	3.9	1991	4.0	1992	4.0	1993	4.0	1994	4.0	1995	3.9	1996	3.9
1987	3.8	1988	3.8	1989	3.7	1990	3.8	1991	3.9	1992	3.8	1993	3.9	1994	3.8	1995	3.8	1996	3.8	1997	3.7
1988	3.6	1989	3.6	1990	3.6	1991	3.7	1992	3.7	1993	3.7	1994	3.7	1995	3.6	1996	3.6	1997	3.4	1998	3.3
1989	3.4	1990	3.5	1991	3.5	1992	3.5	1993	3.5	1994	3.5	1995	3.5	1996	3.4	1997	3.3	1998	3.0	1999	3.0
1990	3.3	1991	3.3	1992	3.3	1993	3.3	1994	3.3	1995	3.3	1996	3.2	1997	3.0	1998	2.9	1999	2.9	2000	2.9
1991	3.1	1992	3.1	1993	3.1	1994	3.1	1995	3.1	1996	3.0	1997	2.9	1998	2.6	1999	2.7	2000	2.7	2001	2.7
1992	2.9	1993	2.9	1994	2.9	1995	2.9	1996	2.8	1997	2.7	1998	2.5	1999	2.4	2000	2.4	2001	2.4	2002	2.4
1993	2.7	1994	2.6	1995	2.7	1996	2.6	1997	2.4	1998	2.3	1999	2.2	2000	2.2	2001	2.2	2002	2.2	2003	2.2
1994	2.4	1995	2.4	1996	2.4	1997	2.2	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0
1995	2.2	1996	2.1	1997	2.0	1998	1.8	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7	2004	1.7	2005	1.7
1996	1.8	1997	1.7	1998	1.6	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4	2005	1.4	2006	1.4
1997	1.5	1998	1.4	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2
1998	1.2	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1	2007	1.1	2008	1.1
1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0	2008	1.0	2009	1.0
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 4.11A.1 minus the uncontrolled refueling values in Table 4.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-21. CO Emission Factors for Low Altitude HDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	276.0	1977	236.3	1978	236.3	1979	164.5	1980	154.9	1981	146.6	1982	147.3	1983	147.2	1984	146.6	1985	55.9	1986	48.1
1977	234.2	1978	234.2	1979	162.5	1980	153.0	1981	144.8	1982	145.5	1983	145.4	1984	144.8	1985	55.5	1986	47.7	1987	26.0
1978	232.0	1979	160.4	1980	151.0	1981	142.9	1982	143.6	1983	143.5	1984	142.9	1985	55.1	1986	47.3	1987	25.7	1988	25.9
1979	158.1	1980	148.8	1981	140.9	1982	141.5	1983	141.5	1984	140.9	1985	54.7	1986	46.9	1987	25.4	1988	25.6	1989	25.6
1980	146.5	1981	138.7	1982	139.3	1983	139.3	1984	138.7	1985	54.3	1986	46.5	1987	25.0	1988	25.3	1989	25.3	1990	25.6
1981	136.4	1982	137.0	1983	137.0	1984	136.4	1985	53.8	1986	46.0	1987	24.7	1988	24.9	1989	24.9	1990	25.2	1991	25.1
1982	134.5	1983	134.5	1984	133.9	1985	53.3	1986	45.5	1987	24.3	1988	24.5	1989	24.5	1990	24.8	1991	24.7	1992	24.7
1983	131.9	1984	131.3	1985	52.8	1986	45.0	1987	23.9	1988	24.1	1989	24.1	1990	24.4	1991	24.3	1992	24.3	1993	24.3
1984	128.5	1985	52.2	1986	44.4	1987	23.5	1988	23.7	1989	23.7	1990	24.0	1991	23.8	1992	23.9	1993	23.9	1994	23.9
1985	51.6	1986	43.8	1987	23.0	1988	23.2	1989	23.2	1990	23.5	1991	23.4	1992	23.4	1993	23.4	1994	23.4	1995	23.4
1986	43.2	1987	22.5	1988	22.7	1989	22.7	1990	22.9	1991	22.9	1992	22.9	1993	22.9	1994	22.9	1995	22.9	1996	22.9
1987	22.0	1988	22.2	1989	22.2	1990	22.4	1991	22.4	1992	22.4	1993	22.4	1994	22.4	1995	22.4	1996	22.4	1997	22.4
1988	21.6	1989	21.6	1990	21.8	1991	21.8	1992	21.8	1993	21.8	1994	21.8	1995	21.8	1996	21.8	1997	21.8	1998	21.8
1989	21.0	1990	21.2	1991	21.2	1992	21.2	1993	21.2	1994	21.2	1995	21.2	1996	21.2	1997	21.2	1998	21.1	1999	21.2
1990	20.6	1991	20.6	1992	20.6	1993	20.6	1994	20.6	1995	20.6	1996	20.6	1997	20.6	1998	20.5	1999	20.5	2000	20.5
1991	19.9	1992	19.9	1993	19.9	1994	19.9	1995	19.9	1996	19.9	1997	19.9	1998	19.8	1999	19.8	2000	19.8	2001	19.8
1992	19.2	1993	19.2	1994	19.2	1995	19.2	1996	19.2	1997	19.2	1998	19.1	1999	19.1	2000	19.1	2001	19.1	2002	19.1
1993	18.4	1994	18.4	1995	18.4	1996	18.4	1997	18.3	1998	18.3	1999	18.3	2000	18.3	2001	18.3	2002	18.3	2003	18.3
1994	17.5	1995	17.6	1996	17.6	1997	17.5	1998	17.5	1999	17.5	2000	17.5	2001	17.5	2002	17.5	2003	17.5	2004	17.5
1995	16.7	1996	16.7	1997	16.6	1998	16.6	1999	16.5	2000	16.6	2001	16.6	2002	16.6	2003	16.6	2004	16.6	2005	16.6
1996	15.7	1997	15.7	1998	15.7	1999	15.6	2000	15.6	2001	15.6	2002	15.6	2003	15.6	2004	15.6	2005	15.6	2006	15.6
1997	14.7	1998	14.7	1999	14.6	2000	14.6	2001	14.6	2002	14.6	2003	14.6	2004	14.6	2005	14.6	2006	14.6	2007	14.6
1998	13.6	1999	13.6	2000	13.5	2001	13.5	2002	13.5	2003	13.5	2004	13.5	2005	13.5	2006	13.5	2007	13.5	2008	13.5
1999	12.4	2000	12.4	2001	12.4	2002	12.4	2003	12.4	2004	12.4	2005	12.4	2006	12.4	2007	12.4	2008	12.4	2009	12.4
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 4.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-22. NO_X Emission Factors for Low Altitude HDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	7.7	1977	6.6	1978	6.6	1979	7.2	1980	6.8	1981	6.4	1982	6.3	1983	6.3	1984	6.3	1985	5.8	1986	5.8
1977	6.6	1978	6.5	1979	7.2	1980	6.8	1981	6.3	1982	6.3	1983	6.3	1984	6.4	1985	5.8	1986	5.8	1987	6.0
1978	6.5	1979	7.1	1980	6.9	1981	6.3	1982	6.3	1983	6.3	1984	6.3	1985	5.8	1986	5.8	1987	5.9	1988	6.0
1979	7.1	1980	6.8	1981	6.3	1982	6.3	1983	6.3	1984	6.3	1985	5.8	1986	5.8	1987	5.9	1988	5.9	1989	5.9
1980	6.8	1981	6.2	1982	6.2	1983	6.3	1984	6.2	1985	5.8	1986	5.8	1987	5.9	1988	5.9	1989	5.9	1990	5.2
1981	6.2	1982	6.2	1983	6.2	1984	6.2	1985	5.8	1986	5.8	1987	5.9	1988	5.9	1989	5.9	1990	5.2	1991	4.5
1982	6.2	1983	6.2	1984	6.2	1985	5.8	1986	5.7	1987	5.9	1988	5.9	1989	6.0	1990	5.2	1991	4.4	1992	4.5
1983	6.2	1984	6.1	1985	5.7	1986	5.7	1987	5.9	1988	5.9	1989	5.9	1990	5.1	1991	4.4	1992	4.4	1993	4.4
1984	6.1	1985	5.7	1986	5.7	1987	5.9	1988	5.8	1989	5.9	1990	5.1	1991	4.3	1992	4.4	1993	4.4	1994	4.4
1985	5.7	1986	5.7	1987	5.8	1988	5.8	1989	5.8	1990	5.1	1991	4.3	1992	4.4	1993	4.4	1994	4.3	1995	4.4
1986	5.7	1987	5.8	1988	5.8	1989	5.8	1990	5.1	1991	4.3	1992	4.3	1993	4.4	1994	4.3	1995	4.3	1996	4.3
1987	5.8	1988	5.8	1989	5.8	1990	5.1	1991	4.3	1992	4.3	1993	4.3	1994	4.3	1995	4.3	1996	4.3	1997	4.3
1988	5.8	1989	5.7	1990	5.0	1991	4.3	1992	4.2	1993	4.3	1994	4.2	1995	4.3	1996	4.3	1997	4.2	1998	3.5
1989	5.7	1990	5.0	1991	4.2	1992	4.2	1993	4.2	1994	4.2	1995	4.2	1996	4.3	1997	4.2	1998	3.5	1999	3.5
1990	5.0	1991	4.2	1992	4.2	1993	4.2	1994	4.2	1995	4.2	1996	4.2	1997	4.2	1998	3.4	1999	3.4	2000	3.4
1991	4.2	1992	4.1	1993	4.2	1994	4.2	1995	4.1	1996	4.2	1997	4.1	1998	3.4	1999	3.4	2000	3.4	2001	3.4
1992	4.1	1993	4.1	1994	4.1	1995	4.1	1996	4.2	1997	4.1	1998	3.4	1999	3.4	2000	3.4	2001	3.4	2002	3.4
1993	4.1	1994	4.0	1995	4.1	1996	4.1	1997	4.1	1998	3.3	1999	3.3	2000	3.3	2001	3.3	2002	3.3	2003	3.3
1994	4.0	1995	4.0	1996	4.0	1997	4.0	1998	3.3	1999	3.3	2000	3.3	2001	3.3	2002	3.3	2003	3.3	2004	3.3
1995	4.0	1996	4.0	1997	3.9	1998	3.2	1999	3.2	2000	3.2	2001	3.2	2002	3.2	2003	3.2	2004	3.2	2005	3.2
1996	3.9	1997	3.9	1998	3.2	1999	3.2	2000	3.2	2001	3.2	2002	3.2	2003	3.2	2004	3.2	2005	3.2	2006	3.2
1997	3.8	1998	3.1	1999	3.1	2000	3.1	2001	3.1	2002	3.1	2003	3.1	2004	3.1	2005	3.1	2006	3.1	2007	3.1
1998	3.0	1999	3.0	2000	3.0	2001	3.0	2002	3.0	2003	3.0	2004	3.0	2005	3.0	2006	3.0	2007	3.0	2008	3.0
1999	3.0	2000	3.0	2001	3.0	2002	3.0	2003	3.0	2004	3.0	2005	3.0	2006	3.0	2007	3.0	2008	3.0	2009	3.0
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 4.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-23. VOC Emission Factors for High Altitude HDGV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	21.7	1977	19.4	1978	19.4	1979	14.3	1980	13.8	1981	13.3	1982	13.4	1983	13.3	1984	13.4	1985	6.3	1986	5.8
1977	19.3	1978	19.3	1979	14.2	1980	13.7	1981	13.3	1982	13.3	1983	13.3	1984	13.3	1985	6.2	1986	5.8	1987	5.7
1978	19.2	1979	14.2	1980	13.6	1981	13.2	1982	13.3	1983	13.2	1984	13.3	1985	6.0	1986	5.7	1987	5.6	1988	5.6
1979	14.1	1980	13.6	1981	13.1	1982	13.2	1983	13.2	1984	13.2	1985	6.0	1986	5.6	1987	5.5	1988	5.5	1989	5.5
1980	13.5	1981	13.0	1982	13.1	1983	13.1	1984	13.1	1985	5.9	1986	5.5	1987	5.3	1988	5.4	1989	5.4	1990	5.5
1981	12.9	1982	13.0	1983	13.0	1984	13.0	1985	5.9	1986	5.4	1987	5.2	1988	5.3	1989	5.3	1990	5.4	1991	5.4
1982	12.9	1983	12.9	1984	12.9	1985	5.8	1986	5.4	1987	5.1	1988	5.2	1989	5.2	1990	5.3	1991	5.2	1992	5.3
1983	12.8	1984	12.8	1985	5.7	1986	5.3	1987	5.0	1988	5.1	1989	5.1	1990	5.2	1991	5.1	1992	5.1	1993	5.1
1984	12.7	1985	5.6	1986	5.2	1987	4.9	1988	4.9	1989	4.9	1990	5.1	1991	5.0	1992	5.0	1993	5.0	1994	5.0
1985	5.5	1986	5.0	1987	4.8	1988	4.8	1989	4.9	1990	4.9	1991	4.9	1992	4.9	1993	4.9	1994	4.8	1995	4.9
1986	4.9	1987	4.6	1988	4.6	1989	4.7	1990	4.8	1991	4.7	1992	4.8	1993	4.7	1994	4.7	1995	4.8	1996	4.6
1987	4.5	1988	4.5	1989	4.5	1990	4.6	1991	4.6	1992	4.6	1993	4.6	1994	4.5	1995	4.6	1996	4.5	1997	4.3
1988	4.3	1989	4.3	1990	4.4	1991	4.4	1992	4.4	1993	4.4	1994	4.4	1995	4.4	1996	4.3	1997	4.1	1998	3.9
1989	4.1	1990	4.2	1991	4.2	1992	4.2	1993	4.2	1994	4.2	1995	4.2	1996	4.1	1997	4.0	1998	3.6	1999	3.7
1990	4.0	1991	4.0	1992	4.0	1993	4.0	1994	4.0	1995	4.0	1996	3.9	1997	3.7	1998	3.5	1999	3.5	2000	3.5
1991	3.8	1992	3.8	1993	3.8	1994	3.8	1995	3.8	1996	3.7	1997	3.6	1998	3.2	1999	3.3	2000	3.3	2001	3.3
1992	3.6	1993	3.5	1994	3.6	1995	3.6	1996	3.4	1997	3.4	1998	3.1	1999	3.0	2000	3.0	2001	3.0	2002	3.0
1993	3.3	1994	3.3	1995	3.4	1996	3.2	1997	3.1	1998	2.9	1999	2.8	2000	2.8	2001	2.8	2002	2.8	2003	2.8
1994	3.1	1995	3.1	1996	3.0	1997	2.9	1998	2.6	1999	2.6	2000	2.6	2001	2.6	2002	2.6	2003	2.6	2004	2.6
1995	2.8	1996	2.7	1997	2.7	1998	2.4	1999	2.3	2000	2.3	2001	2.3	2002	2.3	2003	2.3	2004	2.3	2005	2.3
1996	2.4	1997	2.4	1998	2.2	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0	2005	2.0	2006	2.0
1997	2.2	1998	1.9	1999	1.8	2000	1.8	2001	1.8	2002	1.8	2003	1.8	2004	1.8	2005	1.8	2006	1.8	2007	1.8
1998	1.8	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7	2004	1.7	2005	1.7	2006	1.7	2007	1.7	2008	1.7
1999	1.6	2000	1.6	2001	1.6	2002	1.6	2003	1.6	2004	1.6	2005	1.6	2006	1.6	2007	1.6	2008	1.6	2009	1.6
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons minus emissions associated with vehicle refueling.

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are based on applicable Tables found in Appendix H of AP-42, Volume II. Specifically, they are equal to the values in Table 4.11A.2 minus the uncontrolled refueling values in Table 4.2D.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-24. CO Emission Factors for High Altitude HDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	392.5	1977	336.0	1978	336.0	1979	210.9	1980	198.4	1981	187.9	1982	188.7	1983	188.7	1984	188.0	1985	85.0	1986	71.0
1977	333.9	1978	333.9	1979	208.9	1980	196.5	1981	186.1	1982	186.9	1983	186.9	1984	186.1	1985	84.6	1986	70.7	1987	46.4
1978	331.7	1979	206.8	1980	194.5	1981	184.2	1982	184.9	1983	185.0	1984	184.2	1985	84.2	1986	70.3	1987	46.1	1988	46.5
1979	204.5	1980	192.4	1981	182.2	1982	182.9	1983	183.0	1984	182.2	1985	83.8	1986	69.9	1987	45.8	1988	46.1	1989	46.2
1980	190.1	1981	180.0	1982	180.7	1983	180.8	1984	180.0	1985	83.4	1986	69.5	1987	45.4	1988	45.8	1989	45.9	1990	46.3
1981	177.7	1982	178.4	1983	178.5	1984	177.7	1985	82.9	1986	69.0	1987	45.1	1988	45.5	1989	45.5	1990	46.0	1991	45.8
1982	176.0	1983	176.0	1984	175.2	1985	82.4	1986	68.4	1987	44.7	1988	45.1	1989	45.0	1990	45.6	1991	45.4	1992	45.5
1983	173.3	1984	172.6	1985	81.9	1986	67.9	1987	44.3	1988	44.7	1989	44.6	1990	45.2	1991	45.0	1992	45.0	1993	45.0
1984	169.8	1985	81.3	1986	67.3	1987	43.9	1988	44.3	1989	44.2	1990	44.8	1991	44.5	1992	44.6	1993	44.6	1994	44.6
1985	80.7	1986	66.7	1987	43.4	1988	43.8	1989	43.8	1990	44.3	1991	44.1	1992	44.1	1993	44.1	1994	44.1	1995	44.1
1986	66.1	1987	42.9	1988	43.3	1989	43.3	1990	43.7	1991	43.6	1992	43.6	1993	43.6	1994	43.6	1995	43.6	1996	43.6
1987	42.4	1988	42.8	1989	42.8	1990	43.2	1991	43.1	1992	43.1	1993	43.1	1994	43.0	1995	43.1	1996	43.1	1997	43.1
1988	42.2	1989	42.2	1990	42.6	1991	42.5	1992	42.5	1993	42.5	1994	42.5	1995	42.5	1996	42.5	1997	42.5	1998	42.4
1989	41.6	1990	42.0	1991	41.9	1992	41.9	1993	41.9	1994	41.9	1995	41.9	1996	41.9	1997	41.9	1998	41.7	1999	41.8
1990	41.4	1991	41.3	1992	41.3	1993	41.3	1994	41.3	1995	41.3	1996	41.3	1997	41.3	1998	41.1	1999	41.1	2000	41.1
1991	40.6	1992	40.6	1993	40.6	1994	40.6	1995	40.6	1996	40.6	1997	40.6	1998	40.4	1999	40.4	2000	40.4	2001	40.4
1992	39.9	1993	39.9	1994	39.9	1995	39.9	1996	39.9	1997	39.9	1998	39.7	1999	39.7	2000	39.7	2001	39.7	2002	39.7
1993	39.1	1994	39.1	1995	39.1	1996	39.1	1997	39.1	1998	38.9	1999	38.9	2000	38.9	2001	38.9	2002	38.9	2003	38.9
1994	38.3	1995	38.3	1996	38.3	1997	38.3	1998	38.1	1999	38.1	2000	38.1	2001	38.0	2002	38.0	2003	38.0	2004	38.0
1995	37.4	1996	37.4	1997	37.4	1998	37.2	1999	37.1	2000	37.2	2001	37.2	2002	37.2	2003	37.2	2004	37.2	2005	37.2
1996	36.4	1997	36.4	1998	36.3	1999	36.2	2000	36.2	2001	36.2	2002	36.2	2003	36.2	2004	36.2	2005	36.2	2006	36.2
1997	35.4	1998	35.3	1999	35.2	2000	35.2	2001	35.2	2002	35.2	2003	35.2	2004	35.2	2005	35.2	2006	35.2	2007	35.2
1998	34.2	1999	34.2	2000	34.1	2001	34.1	2002	34.1	2003	34.1	2004	34.1	2005	34.1	2006	34.1	2007	34.1	2008	34.1
1999	33.0	2000	33.0	2001	33.0	2002	33.0	2003	33.0	2004	33.0	2005	33.0	2006	33.0	2007	33.0	2008	33.0	2009	33.0
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 4.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-25. NO_X Emission Factors for High Altitude HDGV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	5.6	1977	4.8	1978	4.9	1979	5.3	1980	5.0	1981	4.6	1982	4.6	1983	4.7	1984	4.6	1985	4.1	1986	4.1
1977	4.8	1978	4.8	1979	5.3	1980	5.0	1981	4.6	1982	4.6	1983	4.6	1984	4.5	1985	4.1	1986	4.1	1987	4.2
1978	4.8	1979	5.2	1980	5.0	1981	4.6	1982	4.5	1983	4.6	1984	4.5	1985	4.1	1986	4.1	1987	4.2	1988	4.2
1979	5.2	1980	4.9	1981	4.5	1982	4.5	1983	4.5	1984	4.5	1985	4.1	1986	4.0	1987	4.2	1988	4.1	1989	4.2
1980	4.9	1981	4.5	1982	4.5	1983	4.5	1984	4.5	1985	4.1	1986	4.0	1987	4.1	1988	4.1	1989	4.1	1990	4.4
1981	4.5	1982	4.5	1983	4.5	1984	4.5	1985	4.0	1986	4.0	1987	4.1	1988	4.1	1989	4.1	1990	4.3	1991	3.7
1982	4.5	1983	4.4	1984	4.4	1985	4.0	1986	4.0	1987	4.1	1988	4.1	1989	4.1	1990	4.3	1991	3.7	1992	3.7
1983	4.4	1984	4.4	1985	4.0	1986	4.0	1987	4.1	1988	4.1	1989	4.1	1990	4.2	1991	3.7	1992	3.7	1993	3.7
1984	4.4	1985	4.0	1986	3.9	1987	4.1	1988	4.1	1989	4.1	1990	4.2	1991	3.7	1992	3.7	1993	3.6	1994	3.7
1985	4.0	1986	3.9	1987	4.0	1988	4.1	1989	4.0	1990	4.2	1991	3.6	1992	3.7	1993	3.6	1994	3.6	1995	3.6
1986	3.9	1987	4.0	1988	4.0	1989	4.0	1990	4.2	1991	3.6	1992	3.6	1993	3.6	1994	3.6	1995	3.6	1996	3.6
1987	4.0	1988	4.0	1989	4.0	1990	4.2	1991	3.5	1992	3.6	1993	3.5	1994	3.6	1995	3.6	1996	3.5	1997	3.6
1988	4.0	1989	4.0	1990	4.1	1991	3.5	1992	3.5	1993	3.5	1994	3.5	1995	3.6	1996	3.5	1997	3.5	1998	2.9
1989	4.0	1990	4.1	1991	3.5	1992	3.5	1993	3.5	1994	3.5	1995	3.5	1996	3.5	1997	3.5	1998	2.9	1999	2.9
1990	4.1	1991	3.4	1992	3.5	1993	3.5	1994	3.4	1995	3.5	1996	3.4	1997	3.5	1998	2.9	1999	2.9	2000	2.9
1991	3.4	1992	3.4	1993	3.4	1994	3.4	1995	3.5	1996	3.4	1997	3.4	1998	2.8	1999	2.8	2000	2.8	2001	2.8
1992	3.4	1993	3.3	1994	3.4	1995	3.4	1996	3.3	1997	3.4	1998	2.8	1999	2.8	2000	2.8	2001	2.8	2002	2.8
1993	3.3	1994	3.3	1995	3.3	1996	3.3	1997	3.4	1998	2.7	1999	2.7	2000	2.7	2001	2.7	2002	2.7	2003	2.7
1994	3.3	1995	3.3	1996	3.3	1997	3.3	1998	2.7	1999	2.7	2000	2.7	2001	2.7	2002	2.7	2003	2.7	2004	2.7
1995	3.2	1996	3.2	1997	3.2	1998	2.6	1999	2.6	2000	2.6	2001	2.6	2002	2.6	2003	2.6	2004	2.6	2005	2.6
1996	3.2	1997	3.2	1998	2.6	1999	2.6	2000	2.6	2001	2.6	2002	2.6	2003	2.6	2004	2.6	2005	2.6	2006	2.6
1997	3.1	1998	2.5	1999	2.5	2000	2.5	2001	2.5	2002	2.5	2003	2.5	2004	2.5	2005	2.5	2006	2.5	2007	2.5
1998	2.4	1999	2.4	2000	2.4	2001	2.4	2002	2.4	2003	2.4	2004	2.4	2005	2.4	2006	2.4	2007	2.4	2008	2.4
1999	2.4	2000	2.4	2001	2.4	2002	2.4	2003	2.4	2004	2.4	2005	2.4	2006	2.4	2007	2.4	2008	2.4	2009	2.4
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 4.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-26. VOC Emission Factors for Low Altitude LDDV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	1.8	1977	1.8	1978	1.8	1979	1.8	1980	0.9	1981	0.9	1982	0.9	1983	0.9	1984	0.9	1985	0.9	1986	0.9
1977	1.8	1978	1.8	1979	1.8	1980	0.9	1981	0.9	1982	0.9	1983	0.9	1984	0.9	1985	0.9	1986	0.9	1987	0.9
1978	1.8	1979	1.8	1980	0.9	1981	0.9	1982	0.9	1983	0.9	1984	0.9	1985	0.9	1986	0.9	1987	0.9	1988	0.0
1979	1.7	1980	0.8	1981	0.8	1982	0.8	1983	0.8	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0
1980	0.8	1981	0.8	1982	0.8	1983	0.8	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0
1981	0.8	1982	0.8	1983	0.8	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8
1982	0.8	1983	0.8	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8
1983	0.8	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8	1993	0.8
1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8	1993	0.8	1994	0.8
1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8	1993	0.8	1994	0.8	1995	0.8
1986	0.7	1987	0.7	1988	0.0	1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7
1987	0.7	1988	0.0	1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7
1988	0.0	1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7	1998	0.7
1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7	1998	0.7	1999	0.7
1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7	1998	0.7	1999	0.7	2000	0.7
1991	0.6	1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6
1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6
1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6
1994	0.5	1995	0.5	1996	0.5	1997	0.5	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5
1995	0.5	1996	0.5	1997	0.5	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5
1996	0.5	1997	0.5	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5
1997	0.4	1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3	2010	0.3

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 5.11A.1 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-27. CO Emission Factors for Low Altitude LDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	3.0	1977	3.0	1978	3.0	1979	3.0	1980	1.9	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9
1977	2.9	1978	2.9	1979	2.9	1980	1.9	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9	1987	1.9
1978	2.9	1979	2.9	1980	1.9	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0
1979	2.9	1980	1.9	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0
1980	1.9	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0	1990	0.0
1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0	1990	0.0	1991	1.9
1982	1.9	1983	1.9	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0	1990	0.0	1991	1.9	1992	1.9
1983	1.8	1984	1.8	1985	1.8	1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8
1984	1.8	1985	1.8	1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8	1994	1.8
1985	1.8	1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8	1994	1.8	1995	1.8
1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8	1994	1.8	1995	1.8	1996	1.8
1987	1.7	1988	0.0	1989	0.0	1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7
1988	0.0	1989	0.0	1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7
1989	0.0	1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7
1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7	2000	1.7
1991	1.6	1992	1.6	1993	1.6	1994	1.6	1995	1.6	1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6
1992	1.6	1993	1.6	1994	1.6	1995	1.6	1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6
1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5
1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5
1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4	2005	1.4
1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4	2005	1.4	2006	1.4
1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3	2006	1.3	2007	1.3
1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3	2006	1.3	2007	1.3	2008	1.3
1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2	2008	1.2	2009	1.2
2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2	2008	1.2	2009	1.2	2010	1.2

[a] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 5.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-28. NO_X Emission Factors for Low Altitude LDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	2.2	1977	2.2	1978	2.2	1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.5	1986	1.5
1977	2.2	1978	2.2	1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.5	1986	1.5	1987	1.5
1978	2.2	1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.5	1986	1.5	1987	1.5	1988	0.0
1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0
1980	2.1	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0
1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4
1982	1.8	1983	1.8	1984	1.8	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4
1983	1.8	1984	1.8	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4	1993	1.4
1984	1.8	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4	1993	1.4	1994	1.4
1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4	1993	1.4	1994	1.4	1995	1.4
1986	1.3	1987	1.3	1988	0.0	1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3
1987	1.3	1988	0.0	1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3	1997	1.3
1988	0.0	1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3	1997	1.3	1998	1.3
1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3	1997	1.3	1998	1.3	1999	1.3
1990	0.0	1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2
1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2
1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2
1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2
1994	1.1	1995	1.1	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1
1995	1.1	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1
1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1
1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0
1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0	2008	1.0
1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9	2008	0.9	2009	0.9
2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9	2008	0.9	2009	0.9	2010	0.9

[a] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 5.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-29. VOC Emission Factors for High Altitude LDDV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	2.3	1977	2.3	1978	2.3	1979	2.3	1980	1.2	1981	1.2	1982	1.0	1983	1.0	1984	0.9	1985	0.9	1986	0.9
1977	2.3	1978	2.3	1979	2.3	1980	1.2	1981	1.2	1982	1.0	1983	1.0	1984	0.9	1985	0.9	1986	0.9	1987	0.9
1978	2.3	1979	2.3	1980	1.2	1981	1.2	1982	1.0	1983	1.0	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0
1979	2.3	1980	1.2	1981	1.2	1982	0.9	1983	0.9	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0
1980	1.2	1981	1.2	1982	0.9	1983	0.9	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0
1981	1.2	1982	0.9	1983	0.9	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8
1982	0.9	1983	0.9	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8
1983	0.9	1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8	1993	0.8
1984	0.8	1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8	1993	0.8	1994	0.8
1985	0.8	1986	0.8	1987	0.8	1988	0.0	1989	0.0	1990	0.0	1991	0.8	1992	0.8	1993	0.8	1994	0.8	1995	0.8
1986	0.7	1987	0.7	1988	0.0	1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7
1987	0.7	1988	0.0	1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7
1988	0.0	1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7	1998	0.7
1989	0.0	1990	0.0	1991	0.7	1992	0.7	1993	0.7	1994	0.7	1995	0.7	1996	0.7	1997	0.7	1998	0.7	1999	0.7
1990	0.0	1991	0.6	1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6
1991	0.6	1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6
1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6
1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6
1994	0.5	1995	0.5	1996	0.5	1997	0.5	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5
1995	0.5	1996	0.5	1997	0.5	1998	0.5	1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5
1996	0.4	1997	0.4	1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4
1997	0.4	1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4
1998	0.4	1999	0.4	2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4
1999	0.3	2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3
2000	0.3	2001	0.3	2002	0.3	2003	0.3	2004	0.3	2005	0.3	2006	0.3	2007	0.3	2008	0.3	2009	0.3	2010	0.3

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 5.11A.2 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-30. CO Emission Factors for High Altitude LDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	3.8	1977	3.9	1978	3.9	1979	3.8	1980	2.8	1981	2.8	1982	2.8	1983	2.8	1984	1.9	1985	1.9	1986	1.9
1977	3.8	1978	3.8	1979	3.8	1980	2.8	1981	2.8	1982	2.8	1983	2.8	1984	1.9	1985	1.9	1986	1.9	1987	1.9
1978	3.8	1979	3.8	1980	2.8	1981	2.8	1982	2.8	1983	2.8	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0
1979	3.8	1980	2.8	1981	2.8	1982	2.8	1983	2.8	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0
1980	2.8	1981	2.8	1982	2.8	1983	2.8	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0	1990	0.0
1981	2.7	1982	2.7	1983	2.7	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0	1990	0.0	1991	1.9
1982	2.7	1983	2.7	1984	1.9	1985	1.9	1986	1.9	1987	1.9	1988	0.0	1989	0.0	1990	0.0	1991	1.9	1992	1.9
1983	2.7	1984	1.8	1985	1.8	1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8
1984	1.8	1985	1.8	1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8	1994	1.8
1985	1.8	1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8	1994	1.8	1995	1.8
1986	1.8	1987	1.8	1988	0.0	1989	0.0	1990	0.0	1991	1.8	1992	1.8	1993	1.8	1994	1.8	1995	1.8	1996	1.8
1987	1.7	1988	0.0	1989	0.0	1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7
1988	0.0	1989	0.0	1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7
1989	0.0	1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7
1990	0.0	1991	1.7	1992	1.7	1993	1.7	1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7	2000	1.7
1991	1.6	1992	1.7	1993	1.6	1994	1.6	1995	1.6	1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6
1992	1.6	1993	1.6	1994	1.6	1995	1.6	1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6
1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5
1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5
1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4	2005	1.4
1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4	2005	1.4	2006	1.4
1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3	2006	1.3	2007	1.3
1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3	2006	1.3	2007	1.3	2008	1.3
1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2	2008	1.2	2009	1.2
2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2	2008	1.2	2009	1.2	2010	1.2

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 5.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-31. NO_X Emission Factors for High Altitude LDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	2.2	1977	2.2	1978	2.2	1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.5	1986	1.5
1977	2.2	1978	2.2	1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.5	1986	1.5	1987	1.5
1978	2.2	1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.5	1986	1.5	1987	1.5	1988	0.0
1979	2.2	1980	2.2	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0
1980	2.1	1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0
1981	1.9	1982	1.9	1983	1.9	1984	1.9	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4
1982	1.8	1983	1.8	1984	1.8	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4
1983	1.8	1984	1.8	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4	1993	1.4
1984	1.8	1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4	1993	1.4	1994	1.4
1985	1.4	1986	1.4	1987	1.4	1988	0.0	1989	0.0	1990	0.0	1991	1.4	1992	1.4	1993	1.4	1994	1.4	1995	1.4
1986	1.3	1987	1.3	1988	0.0	1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3
1987	1.3	1988	0.0	1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3	1997	1.3
1988	0.0	1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3	1997	1.3	1998	1.3
1989	0.0	1990	0.0	1991	1.3	1992	1.3	1993	1.3	1994	1.3	1995	1.3	1996	1.3	1997	1.3	1998	1.3	1999	1.3
1990	0.0	1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2
1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2
1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2
1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2
1994	1.1	1995	1.1	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1
1995	1.1	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1
1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1
1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0
1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0	2008	1.0
1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9	2008	0.9	2009	0.9
2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9	2008	0.9	2009	0.9	2010	0.9

[a] High altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 5.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-32. VOC Emission Factors for Low Altitude LDDT[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	0.0	1977	0.0	1978	2.5	1979	2.5	1980	2.5	1981	1.3	1982	1.3	1983	1.3	1984	1.3	1985	1.3	1986	1.3
1977	0.0	1978	2.5	1979	2.5	1980	2.5	1981	1.2	1982	1.2	1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2
1978	2.5	1979	2.5	1980	2.5	1981	1.2	1982	1.2	1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2
1979	2.4	1980	2.5	1981	1.2	1982	1.2	1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2
1980	2.4	1981	1.2	1982	1.2	1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2
1981	1.2	1982	1.2	1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2
1982	1.2	1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2	1992	1.2
1983	1.2	1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2	1992	1.2	1993	1.2
1984	1.1	1985	1.1	1986	1.1	1987	1.1	1988	1.1	1989	1.1	1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1
1985	1.1	1986	1.1	1987	1.1	1988	1.1	1989	1.1	1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1	1995	1.1
1986	1.1	1987	1.1	1988	1.1	1989	1.1	1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1	1995	1.1	1996	1.1
1987	1.1	1988	1.1	1989	1.1	1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1	1995	1.1	1996	1.1	1997	1.1
1988	1.0	1989	1.0	1990	1.0	1991	1.0	1992	1.0	1993	1.0	1994	1.0	1995	1.0	1996	1.0	1997	1.0	1998	1.0
1989	1.0	1990	1.0	1991	1.0	1992	1.0	1993	1.0	1994	1.0	1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0
1990	1.0	1991	1.0	1992	1.0	1993	1.0	1994	1.0	1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0	2000	1.0
1991	0.9	1992	0.9	1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9
1992	0.9	1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9
1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9
1994	0.8	1995	0.8	1996	0.8	1997	0.8	1998	0.8	1999	0.8	2000	0.8	2001	0.8	2002	0.8	2003	0.8	2004	0.8
1995	0.7	1996	0.7	1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7
1996	0.7	1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7
1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6
1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6	2008	0.6
1999	0.5	2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5	2008	0.5	2009	0.5
2000	0.4	2001	0.4	2002	0.4	2003	0.4	2004	0.4	2005	0.4	2006	0.4	2007	0.4	2008	0.4	2009	0.4	2010	0.4

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 6.11A.1 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-33. CO Emission Factors for Low Altitude LDDT[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	4.1	1979	4.1	1980	4.1	1981	2.2	1982	2.2	1983	2.2	1984	2.2	1985	2.2	1986	2.2
1977	0.0	1978	4.1	1979	4.1	1980	4.0	1981	2.2	1982	2.2	1983	2.2	1984	2.2	1985	2.2	1986	2.2	1987	2.2
1978	4.0	1979	4.0	1980	4.0	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1
1979	4.0	1980	4.0	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1	1989	2.1
1980	3.9	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1	1989	2.1	1990	2.1
1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.1
1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.1	1992	2.1
1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.1	1992	2.1	1993	2.1
1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.1	1992	2.1	1993	2.1	1994	2.1
1985	2.0	1986	2.0	1987	2.0	1988	2.0	1989	2.0	1990	2.0	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0
1986	2.0	1987	2.0	1988	2.0	1989	2.0	1990	2.0	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0
1987	2.0	1988	2.0	1989	2.0	1990	2.0	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0
1988	2.0	1989	2.0	1990	2.0	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0
1989	1.9	1990	1.9	1991	1.9	1992	1.9	1993	1.9	1994	1.9	1995	1.9	1996	1.9	1997	1.9	1998	1.9	1999	1.9
1990	1.9	1991	1.9	1992	1.9	1993	1.9	1994	1.9	1995	1.9	1996	1.9	1997	1.9	1998	1.9	1999	1.9	2000	1.9
1991	1.9	1992	1.9	1993	1.9	1994	1.9	1995	1.9	1996	1.9	1997	1.9	1998	1.9	1999	1.9	2000	1.9	2001	1.9
1992	1.8	1993	1.8	1994	1.8	1995	1.8	1996	1.8	1997	1.8	1998	1.8	1999	1.8	2000	1.8	2001	1.8	2002	1.8
1993	1.8	1994	1.8	1995	1.8	1996	1.8	1997	1.8	1998	1.8	1999	1.8	2000	1.8	2001	1.8	2002	1.8	2003	1.8
1994	1.7	1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7	2004	1.7
1995	1.7	1996	1.7	1997	1.7	1998	1.7	1999	1.7	2000	1.7	2001	1.7	2002	1.7	2003	1.7	2004	1.7	2005	1.7
1996	1.6	1997	1.6	1998	1.6	1999	1.6	2000	1.6	2001	1.6	2002	1.6	2003	1.6	2004	1.6	2005	1.6	2006	1.6
1997	1.5	1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5	2005	1.5	2006	1.5	2007	1.5
1998	1.5	1999	1.5	2000	1.5	2001	1.5	2002	1.5	2003	1.5	2004	1.5	2005	1.5	2006	1.5	2007	1.5	2008	1.5
1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4	2004	1.4	2005	1.4	2006	1.4	2007	1.4	2008	1.4	2009	1.4
2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3	2006	1.3	2007	1.3	2008	1.3	2009	1.3	2010	1.3

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 6.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-34. NO_X Emission Factors for Low Altitude LDDT[a]

January 1 of Calendar Year																			
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	3.5	1979	3.5	1980	3.5	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1
1977	0.0	1978	3.5	1979	3.5	1980	3.5	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1
1978	3.5	1979	3.5	1980	3.5	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7
1979	3.4	1980	3.5	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7	1989	1.7
1980	3.4	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7	1989	1.7	1990	1.6
1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7	1989	1.7	1990	1.6	1991	1.6
1982	2.1	1983	2.0	1984	2.0	1985	2.1	1986	2.0	1987	2.1	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6
1983	2.0	1984	2.0	1985	2.0	1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6	1993	1.6
1984	2.0	1985	2.0	1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6	1993	1.6	1994	1.6
1985	2.0	1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6	1993	1.6	1994	1.6	1995	1.6
1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5
1987	2.0	1988	1.6	1989	1.6	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5
1988	1.5	1989	1.5	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5
1989	1.5	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5
1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5	2000	1.5
1991	1.4	1992	1.4	1993	1.4	1994	1.4	1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4
1992	1.4	1993	1.4	1994	1.4	1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4
1993	1.4	1994	1.4	1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4
1994	1.3	1995	1.3	1996	1.3	1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3
1995	1.3	1996	1.3	1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3
1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2
1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2
1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1	2007	1.1	2008	1.1
1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1	2007	1.1	2008	1.1	2009	1.1
2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0	2008	1.0	2009	1.0	2010	1.0

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 6.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-35. VOC Emission Factors for High Altitude LDDT[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	0.0	1977	0.0	1978	3.6	1979	3.6	1980	3.6	1981	1.8	1982	1.8	1983	1.8	1984	1.4	1985	1.4	1986	1.4
1977	0.0	1978	3.6	1979	3.6	1980	3.6	1981	1.8	1982	1.8	1983	1.8	1984	1.3	1985	1.3	1986	1.3	1987	1.3
1978	3.5	1979	3.6	1980	3.6	1981	1.8	1982	1.8	1983	1.8	1984	1.3	1985	1.3	1986	1.3	1987	1.3	1988	1.3
1979	3.5	1980	3.5	1981	1.7	1982	1.8	1983	1.7	1984	1.3	1985	1.3	1986	1.3	1987	1.3	1988	1.3	1989	1.3
1980	3.5	1981	1.7	1982	1.7	1983	1.7	1984	1.3	1985	1.3	1986	1.3	1987	1.3	1988	1.3	1989	1.3	1990	1.3
1981	1.7	1982	1.7	1983	1.7	1984	1.3	1985	1.3	1986	1.3	1987	1.3	1988	1.3	1989	1.3	1990	1.3	1991	1.3
1982	1.7	1983	1.7	1984	1.3	1985	1.3	1986	1.3	1987	1.3	1988	1.3	1989	1.3	1990	1.3	1991	1.3	1992	1.3
1983	1.7	1984	1.3	1985	1.3	1986	1.3	1987	1.3	1988	1.3	1989	1.3	1990	1.3	1991	1.3	1992	1.3	1993	1.3
1984	1.2	1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2	1992	1.2	1993	1.2	1994	1.2
1985	1.2	1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2
1986	1.2	1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2
1987	1.2	1988	1.2	1989	1.2	1990	1.2	1991	1.2	1992	1.2	1993	1.2	1994	1.2	1995	1.2	1996	1.2	1997	1.2
1988	1.1	1989	1.1	1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1	1995	1.1	1996	1.1	1997	1.1	1998	1.1
1989	1.1	1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1	1995	1.1	1996	1.1	1997	1.1	1998	1.1	1999	1.1
1990	1.1	1991	1.1	1992	1.1	1993	1.1	1994	1.1	1995	1.1	1996	1.1	1997	1.1	1998	1.1	1999	1.1	2000	1.1
1991	1.0	1992	1.0	1993	1.0	1994	1.0	1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0
1992	1.0	1993	1.0	1994	1.0	1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0
1993	1.0	1994	1.0	1995	1.0	1996	1.0	1997	1.0	1998	1.0	1999	1.0	2000	1.0	2001	1.0	2002	1.0	2003	1.0
1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9
1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9
1996	0.8	1997	0.8	1998	0.8	1999	0.8	2000	0.8	2001	0.8	2002	0.8	2003	0.8	2004	0.8	2005	0.8	2006	0.8
1997	0.7	1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7	2007	0.7
1998	0.7	1999	0.7	2000	0.7	2001	0.7	2002	0.7	2003	0.7	2004	0.7	2005	0.7	2006	0.7	2007	0.7	2008	0.7
1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6	2008	0.6	2009	0.6
2000	0.5	2001	0.5	2002	0.5	2003	0.5	2004	0.5	2005	0.5	2006	0.5	2007	0.5	2008	0.5	2009	0.5	2010	0.5

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 6.11A.2 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-36. CO Emission Factors for High Altitude LDDT[a]

January 1 of Calendar Year																			
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	5.6	1979	5.5	1980	5.6	1981	5.5	1982	5.6	1983	5.6	1984	3.2	1985	3.2	1986	3.2
1977	0.0	1978	5.6	1979	5.6	1980	5.5	1981	5.6	1982	5.5	1983	5.6	1984	3.2	1985	3.2	1986	3.2	1987	3.2
1978	5.5	1979	5.5	1980	5.5	1981	5.5	1982	5.5	1983	5.5	1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1
1979	5.5	1980	5.5	1981	5.5	1982	5.5	1983	5.5	1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1	1989	3.1
1980	5.4	1981	5.5	1982	5.5	1983	5.4	1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1	1989	3.1	1990	3.1
1981	5.4	1982	5.4	1983	5.4	1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1	1989	3.1	1990	3.1	1991	3.1
1982	5.4	1983	5.4	1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1	1989	3.1	1990	3.1	1991	3.1	1992	3.1
1983	5.3	1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1	1989	3.1	1990	3.1	1991	3.1	1992	3.1	1993	3.1
1984	3.1	1985	3.1	1986	3.1	1987	3.1	1988	3.1	1989	3.1	1990	3.1	1991	3.1	1992	3.1	1993	3.1	1994	3.1
1985	3.0	1986	3.0	1987	3.0	1988	3.0	1989	3.0	1990	3.0	1991	3.0	1992	3.0	1993	3.0	1994	3.0	1995	3.0
1986	3.0	1987	3.0	1988	3.0	1989	3.0	1990	3.0	1991	3.0	1992	3.0	1993	3.0	1994	3.0	1995	3.0	1996	3.0
1987	3.0	1988	3.0	1989	3.0	1990	3.0	1991	3.0	1992	3.0	1993	3.0	1994	3.0	1995	3.0	1996	3.0	1997	3.0
1988	3.0	1989	3.0	1990	3.0	1991	3.0	1992	3.0	1993	3.0	1994	3.0	1995	3.0	1996	3.0	1997	3.0	1998	3.0
1989	2.9	1990	2.9	1991	2.9	1992	2.9	1993	2.9	1994	2.9	1995	2.9	1996	2.9	1997	2.9	1998	2.9	1999	2.9
1990	2.9	1991	2.9	1992	2.9	1993	2.9	1994	2.9	1995	2.9	1996	2.9	1997	2.9	1998	2.9	1999	2.9	2000	2.9
1991	2.9	1992	2.9	1993	2.9	1994	2.9	1995	2.9	1996	2.9	1997	2.9	1998	2.9	1999	2.9	2000	2.9	2001	2.9
1992	2.8	1993	2.8	1994	2.8	1995	2.8	1996	2.8	1997	2.8	1998	2.8	1999	2.8	2000	2.8	2001	2.8	2002	2.8
1993	2.8	1994	2.8	1995	2.8	1996	2.8	1997	2.8	1998	2.8	1999	2.8	2000	2.8	2001	2.8	2002	2.8	2003	2.8
1994	2.7	1995	2.7	1996	2.7	1997	2.7	1998	2.7	1999	2.7	2000	2.7	2001	2.7	2002	2.7	2003	2.7	2004	2.7
1995	2.7	1996	2.7	1997	2.7	1998	2.7	1999	2.7	2000	2.7	2001	2.7	2002	2.7	2003	2.7	2004	2.7	2005	2.7
1996	2.6	1997	2.6	1998	2.6	1999	2.6	2000	2.6	2001	2.6	2002	2.6	2003	2.6	2004	2.6	2005	2.6	2006	2.6
1997	2.5	1998	2.5	1999	2.5	2000	2.5	2001	2.5	2002	2.5	2003	2.5	2004	2.5	2005	2.5	2006	2.5	2007	2.5
1998	2.5	1999	2.5	2000	2.5	2001	2.5	2002	2.5	2003	2.5	2004	2.5	2005	2.5	2006	2.5	2007	2.5	2008	2.5
1999	2.4	2000	2.4	2001	2.4	2002	2.4	2003	2.4	2004	2.4	2005	2.4	2006	2.4	2007	2.4	2008	2.4	2009	2.4
2000	2.3	2001	2.3	2002	2.3	2003	2.3	2004	2.3	2005	2.3	2006	2.3	2007	2.3	2008	2.3	2009	2.3	2010	2.3

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 6.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-37. NO_X Emission Factors for High Altitude LDDT[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	3.1	1979	3.1	1980	3.1	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1
1977	0.0	1978	3.1	1979	3.1	1980	3.1	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1
1978	3.1	1979	3.0	1980	3.0	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7
1979	3.0	1980	3.0	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7	1989	1.7
1980	3.0	1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7	1989	1.7	1990	1.6
1981	2.1	1982	2.1	1983	2.1	1984	2.1	1985	2.1	1986	2.1	1987	2.1	1988	1.7	1989	1.7	1990	1.6	1991	1.6
1982	2.1	1983	2.0	1984	2.0	1985	2.1	1986	2.0	1987	2.1	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6
1983	2.0	1984	2.0	1985	2.0	1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6	1993	1.6
1984	2.0	1985	2.0	1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6	1993	1.6	1994	1.6
1985	2.0	1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.6	1991	1.6	1992	1.6	1993	1.6	1994	1.6	1995	1.6
1986	2.0	1987	2.0	1988	1.6	1989	1.6	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5
1987	2.0	1988	1.6	1989	1.6	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5
1988	1.5	1989	1.5	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5
1989	1.5	1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5
1990	1.5	1991	1.5	1992	1.5	1993	1.5	1994	1.5	1995	1.5	1996	1.5	1997	1.5	1998	1.5	1999	1.5	2000	1.5
1991	1.4	1992	1.4	1993	1.4	1994	1.4	1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4
1992	1.4	1993	1.4	1994	1.4	1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4
1993	1.4	1994	1.4	1995	1.4	1996	1.4	1997	1.4	1998	1.4	1999	1.4	2000	1.4	2001	1.4	2002	1.4	2003	1.4
1994	1.3	1995	1.3	1996	1.3	1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3
1995	1.3	1996	1.3	1997	1.3	1998	1.3	1999	1.3	2000	1.3	2001	1.3	2002	1.3	2003	1.3	2004	1.3	2005	1.3
1996	1.2	1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2
1997	1.2	1998	1.2	1999	1.2	2000	1.2	2001	1.2	2002	1.2	2003	1.2	2004	1.2	2005	1.2	2006	1.2	2007	1.2
1998	1.1	1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1	2007	1.1	2008	1.1
1999	1.1	2000	1.1	2001	1.1	2002	1.1	2003	1.1	2004	1.1	2005	1.1	2006	1.1	2007	1.1	2008	1.1	2009	1.1
2000	1.0	2001	1.0	2002	1.0	2003	1.0	2004	1.0	2005	1.0	2006	1.0	2007	1.0	2008	1.0	2009	1.0	2010	1.0

[a] High altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 6.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-38. VOC Emission Factors for Low Altitude HDDV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	6.5	1977	6.7	1978	6.5	1979	3.4	1980	3.1	1981	3.1	1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2
1977	6.6	1978	6.4	1979	3.4	1980	3.1	1981	3.1	1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1
1978	6.4	1979	3.4	1980	3.1	1981	3.1	1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1
1979	3.4	1980	3.1	1981	3.1	1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1
1980	3.1	1981	3.1	1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1
1981	3.1	1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0
1982	2.7	1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0
1983	2.6	1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0
1984	2.7	1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0
1985	2.5	1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0
1986	2.2	1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0
1987	2.1	1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0
1988	2.1	1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0
1989	2.1	1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0
1990	2.1	1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0
1991	2.0	1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0
1992	2.0	1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0
1993	2.0	1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0
1994	2.0	1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0
1995	2.0	1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0	2005	2.0
1996	2.0	1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0	2005	2.0	2006	2.0
1997	2.0	1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0	2005	2.0	2006	2.0	2007	2.0
1998	2.0	1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0	2005	2.0	2006	2.0	2007	2.0	2008	2.0
1999	2.0	2000	2.0	2001	2.0	2002	2.0	2003	2.0	2004	2.0	2005	2.0	2006	2.0	2007	2.0	2008	2.0	2009	2.0
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 7.11A.1 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-39. CO Emission Factors for Low Altitude HDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	19.0	1977	19.1	1978	18.9	1979	19.8	1980	18.0	1981	18.0	1982	15.8	1983	14.9	1984	16.1	1985	14.6	1986	14.7
1977	19.0	1978	18.8	1979	19.7	1980	17.9	1981	17.8	1982	15.8	1983	14.8	1984	15.9	1985	14.6	1986	14.6	1987	14.4
1978	18.7	1979	19.6	1980	17.8	1981	17.7	1982	15.7	1983	14.8	1984	15.8	1985	14.5	1986	14.5	1987	14.2	1988	13.6
1979	19.5	1980	17.7	1981	17.6	1982	15.6	1983	14.7	1984	15.8	1985	14.4	1986	14.4	1987	14.2	1988	13.5	1989	13.5
1980	17.5	1981	17.5	1982	15.5	1983	14.6	1984	15.6	1985	14.3	1986	14.3	1987	14.0	1988	13.4	1989	13.4	1990	13.2
1981	17.4	1982	15.4	1983	14.5	1984	15.5	1985	14.2	1986	14.2	1987	13.9	1988	13.3	1989	13.3	1990	13.1	1991	13.0
1982	15.3	1983	14.4	1984	15.4	1985	14.1	1986	14.1	1987	13.9	1988	13.2	1989	13.2	1990	13.0	1991	12.8	1992	12.9
1983	14.3	1984	15.3	1985	14.0	1986	14.0	1987	13.7	1988	13.1	1989	13.1	1990	12.9	1991	12.8	1992	12.8	1993	12.8
1984	15.1	1985	13.9	1986	13.9	1987	13.6	1988	13.0	1989	13.0	1990	12.8	1991	12.6	1992	12.7	1993	12.6	1994	12.7
1985	13.7	1986	13.8	1987	13.5	1988	12.9	1989	12.9	1990	12.7	1991	12.5	1992	12.5	1993	12.5	1994	12.6	1995	12.5
1986	13.6	1987	13.4	1988	12.8	1989	12.8	1990	12.5	1991	12.4	1992	12.4	1993	12.4	1994	12.4	1995	12.4	1996	12.4
1987	13.2	1988	12.7	1989	12.7	1990	12.4	1991	12.2	1992	12.3	1993	12.2	1994	12.3	1995	12.3	1996	12.3	1997	12.3
1988	12.5	1989	12.5	1990	12.3	1991	12.1	1992	12.1	1993	12.1	1994	12.2	1995	12.1	1996	12.1	1997	12.1	1998	12.1
1989	12.4	1990	12.1	1991	12.0	1992	12.0	1993	12.0	1994	12.0	1995	12.0	1996	12.0	1997	12.0	1998	12.0	1999	12.0
1990	12.0	1991	11.8	1992	11.8	1993	11.8	1994	11.9	1995	11.8	1996	11.8	1997	11.8	1998	11.8	1999	11.8	2000	11.8
1991	11.7	1992	11.7	1993	11.6	1994	11.7	1995	11.7	1996	11.7	1997	11.7	1998	11.7	1999	11.7	2000	11.7	2001	11.7
1992	11.5	1993	11.5	1994	11.5	1995	11.5	1996	11.5	1997	11.5	1998	11.5	1999	11.5	2000	11.5	2001	11.5	2002	11.5
1993	11.3	1994	11.3	1995	11.3	1996	11.3	1997	11.3	1998	11.3	1999	11.3	2000	11.3	2001	11.3	2002	11.3	2003	11.3
1994	11.1	1995	11.1	1996	11.1	1997	11.1	1998	11.1	1999	11.1	2000	11.1	2001	11.1	2002	11.1	2003	11.1	2004	11.1
1995	10.9	1996	10.9	1997	10.9	1998	10.9	1999	10.9	2000	10.9	2001	10.9	2002	10.9	2003	10.9	2004	10.9	2005	10.9
1996	10.7	1997	10.7	1998	10.7	1999	10.7	2000	10.7	2001	10.6	2002	10.6	2003	10.6	2004	10.6	2005	10.6	2006	10.6
1997	10.4	1998	10.4	1999	10.4	2000	10.4	2001	10.4	2002	10.4	2003	10.4	2004	10.4	2005	10.4	2006	10.4	2007	10.4
1998	10.2	1999	10.2	2000	10.2	2001	10.1	2002	10.1	2003	10.1	2004	10.1	2005	10.1	2006	10.1	2007	10.1	2008	10.1
1999	9.9	2000	9.9	2001	9.9	2002	9.9	2003	9.9	2004	9.9	2005	9.9	2006	9.9	2007	9.9	2008	9.9	2009	9.9
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 7.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-40. NO_X Emission Factors for Low Altitude HDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	34.2	1977	34.7	1978	34.1	1979	24.0	1980	21.6	1981	21.6	1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7
1977	34.6	1978	34.0	1979	24.0	1980	21.6	1981	21.6	1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3
1978	33.9	1979	24.0	1980	21.6	1981	21.6	1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9
1979	24.0	1980	21.6	1981	21.6	1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9
1980	21.6	1981	21.6	1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9
1981	21.6	1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2
1982	19.0	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2
1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2
1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2
1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2
1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2
1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2
1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5
1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5
1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5
1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5
1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5
1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5
1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5
1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5
1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5
1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5	2007	6.5
1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5	2007	6.5	2008	6.5
1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5	2007	6.5	2008	6.5	2009	6.5
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 7.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-41. VOC Emission Factors for High Altitude HDDV[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	11.5	1977	11.7	1978	11.5	1979	7.9	1980	7.1	1981	7.1	1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1
1977	11.7	1978	11.4	1979	7.9	1980	7.1	1981	7.1	1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9
1978	11.4	1979	7.9	1980	7.1	1981	7.1	1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9
1979	7.9	1980	7.1	1981	7.1	1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9
1980	7.1	1981	7.1	1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7
1981	7.1	1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7
1982	6.2	1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7
1983	5.9	1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7
1984	6.3	1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7
1985	5.8	1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7
1986	5.1	1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7
1987	4.9	1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7
1988	4.9	1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7
1989	4.9	1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7
1990	4.7	1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7
1991	4.7	1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7
1992	4.7	1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7
1993	4.7	1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7
1994	4.7	1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7
1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7
1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7	2006	4.7
1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7	2006	4.7	2007	4.7
1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7	2006	4.7	2007	4.7	2008	4.7
1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7	2006	4.7	2007	4.7	2008	4.7	2009	4.7
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 7.11A.2 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-42. CO Emission Factors for High Altitude HDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	27.7	1977	28.1	1978	27.6	1979	30.6	1980	27.7	1981	27.7	1982	23.8	1983	23.1	1984	24.7	1985	22.5	1986	22.6
1977	28.0	1978	27.5	1979	30.5	1980	27.6	1981	27.5	1982	23.8	1983	23.1	1984	24.6	1985	22.5	1986	22.5	1987	22.1
1978	27.4	1979	30.4	1980	27.5	1981	27.4	1982	23.7	1983	23.0	1984	24.5	1985	22.4	1986	22.4	1987	22.0	1988	21.2
1979	30.2	1980	27.4	1981	27.3	1982	23.6	1983	22.9	1984	24.4	1985	22.3	1986	22.3	1987	22.0	1988	21.1	1989	21.1
1980	27.2	1981	27.2	1982	23.5	1983	22.8	1984	24.3	1985	22.2	1986	22.2	1987	21.8	1988	21.0	1989	21.1	1990	20.6
1981	27.1	1982	23.4	1983	22.7	1984	24.2	1985	22.1	1986	22.1	1987	21.7	1988	20.9	1989	20.9	1990	20.5	1991	20.3
1982	23.3	1983	22.6	1984	24.1	1985	22.0	1986	22.0	1987	21.6	1988	20.8	1989	20.9	1990	20.4	1991	20.1	1992	20.2
1983	22.4	1984	24.0	1985	21.9	1986	21.9	1987	21.5	1988	20.7	1989	20.8	1990	20.3	1991	20.1	1992	20.1	1993	20.1
1984	23.8	1985	21.8	1986	21.8	1987	21.4	1988	20.6	1989	20.6	1990	20.2	1991	19.9	1992	20.0	1993	19.9	1994	20.0
1985	21.6	1986	21.7	1987	21.3	1988	20.5	1989	20.5	1990	20.1	1991	19.8	1992	19.8	1993	19.8	1994	19.9	1995	19.8
1986	21.5	1987	21.2	1988	20.4	1989	20.4	1990	19.9	1991	19.7	1992	19.7	1993	19.7	1994	19.7	1995	19.7	1996	19.7
1987	21.0	1988	20.3	1989	20.3	1990	19.8	1991	19.5	1992	19.6	1993	19.5	1994	19.6	1995	19.6	1996	19.6	1997	19.6
1988	20.1	1989	20.1	1990	19.7	1991	19.4	1992	19.4	1993	19.4	1994	19.5	1995	19.4	1996	19.4	1997	19.4	1998	19.4
1989	19.9	1990	19.5	1991	19.3	1992	19.3	1993	19.3	1994	19.3	1995	19.3	1996	19.3	1997	19.3	1998	19.3	1999	19.3
1990	19.4	1991	19.1	1992	19.1	1993	19.1	1994	19.2	1995	19.1	1996	19.1	1997	19.1	1998	19.1	1999	19.1	2000	19.1
1991	19.0	1992	19.0	1993	18.9	1994	19.0	1995	19.0	1996	19.0	1997	19.0	1998	19.0	1999	19.0	2000	19.0	2001	18.9
1992	18.8	1993	18.8	1994	18.8	1995	18.8	1996	18.8	1997	18.8	1998	18.8	1999	18.8	2000	18.8	2001	18.8	2002	18.8
1993	18.6	1994	18.6	1995	18.6	1996	18.6	1997	18.6	1998	18.6	1999	18.6	2000	18.6	2001	18.6	2002	18.6	2003	18.6
1994	18.4	1995	18.4	1996	18.4	1997	18.4	1998	18.4	1999	18.4	2000	18.4	2001	18.4	2002	18.4	2003	18.4	2004	18.4
1995	18.2	1996	18.2	1997	18.2	1998	18.2	1999	18.2	2000	18.2	2001	18.2	2002	18.2	2003	18.2	2004	18.2	2005	18.2
1996	18.0	1997	18.0	1998	18.0	1999	17.9	2000	18.0	2001	17.9	2002	17.9	2003	17.9	2004	17.9	2005	17.9	2006	17.9
1997	17.7	1998	17.7	1999	17.7	2000	17.7	2001	17.7	2002	17.7	2003	17.7	2004	17.7	2005	17.7	2006	17.7	2007	17.7
1998	17.4	1999	17.5	2000	17.5	2001	17.4	2002	17.4	2003	17.4	2004	17.4	2005	17.4	2006	17.4	2007	17.4	2008	17.4
1999	17.2	2000	17.2	2001	17.2	2002	17.2	2003	17.2	2004	17.2	2005	17.2	2006	17.2	2007	17.2	2008	17.2	2009	17.2
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 7.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-43. NO_X Emission Factors for High Altitude HDDV[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	34.2	1977	34.7	1978	34.1	1979	24.0	1980	21.6	1981	21.6	1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7
1977	34.6	1978	34.0	1979	24.0	1980	21.6	1981	21.6	1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3
1978	33.9	1979	24.0	1980	21.6	1981	21.6	1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9
1979	24.0	1980	21.6	1981	21.6	1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9
1980	21.6	1981	21.6	1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9
1981	21.6	1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2
1982	18.9	1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2
1983	18.2	1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2
1984	19.2	1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2
1985	17.7	1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2
1986	17.7	1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2
1987	17.3	1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2
1988	16.9	1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5
1989	16.9	1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5
1990	9.9	1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5
1991	8.2	1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5
1992	8.2	1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5
1993	8.2	1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5
1994	8.2	1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5
1995	8.2	1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5
1996	8.2	1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5
1997	8.2	1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5	2007	6.5
1998	6.5	1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5	2007	6.5	2008	6.5
1999	6.5	2000	6.5	2001	6.5	2002	6.5	2003	6.5	2004	6.5	2005	6.5	2006	6.5	2007	6.5	2008	6.5	2009	6.5
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] High altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 7.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-44. VOC Emission Factors for Low Altitude Motorcycles[a,b]

January 1 of Calendar Year																					
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	0.0	1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0
1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0
1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0
1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0
1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0
1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0
1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0
1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0
1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0
1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0
1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0
1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0
1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0	1998	0.0
1989	6.1	1990	6.1	1991	6.1	1992	6.1	1993	6.1	1994	6.1	1995	6.1	1996	6.1	1997	6.1	1998	6.1	1999	6.1
1990	5.9	1991	5.9	1992	5.9	1993	5.9	1994	5.9	1995	5.9	1996	5.9	1997	5.9	1998	5.9	1999	5.9	2000	5.9
1991	5.7	1992	5.7	1993	5.7	1994	5.7	1995	5.7	1996	5.7	1997	5.7	1998	5.7	1999	5.7	2000	5.7	2001	5.7
1992	5.4	1993	5.4	1994	5.4	1995	5.4	1996	5.4	1997	5.4	1998	5.4	1999	5.4	2000	5.4	2001	5.4	2002	5.4
1993	5.2	1994	5.2	1995	5.2	1996	5.2	1997	5.2	1998	5.2	1999	5.2	2000	5.2	2001	5.2	2002	5.2	2003	5.2
1994	4.9	1995	4.9	1996	4.9	1997	4.9	1998	4.9	1999	4.9	2000	4.9	2001	4.9	2002	4.9	2003	4.9	2004	4.9
1995	4.7	1996	4.7	1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7
1996	4.4	1997	4.4	1998	4.4	1999	4.4	2000	4.4	2001	4.4	2002	4.4	2003	4.4	2004	4.4	2005	4.4	2006	4.4
1997	4.1	1998	4.1	1999	4.1	2000	4.1	2001	4.1	2002	4.1	2003	4.1	2004	4.1	2005	4.1	2006	4.1	2007	4.1
1998	3.8	1999	3.8	2000	3.8	2001	3.8	2002	3.8	2003	3.8	2004	3.8	2005	3.8	2006	3.8	2007	3.8	2008	3.8
1999	3.4	2000	3.4	2001	3.4	2002	3.4	2003	3.4	2004	3.4	2005	3.4	2006	3.4	2007	3.4	2008	3.4	2009	3.4
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 8.11A.1 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-45. CO Emission Factors for Low Altitude Motorcycles[a]

January 1 of Calendar Year																				
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0
1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0
1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0
1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0
1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0
1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0
1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0
1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0
1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0
1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0
1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0
1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0
1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0	1998	0.0
1989	25.9	1990	25.9	1991	25.9	1992	25.9	1993	25.9	1994	25.9	1995	25.9	1996	25.9	1997	25.9	1998	25.9	1999	25.9
1990	25.5	1991	25.5	1992	25.5	1993	25.5	1994	25.5	1995	25.5	1996	25.5	1997	25.5	1998	25.5	1999	25.5	2000	25.5
1991	25.0	1992	25.0	1993	25.0	1994	25.0	1995	25.0	1996	25.0	1997	25.0	1998	25.0	1999	25.0	2000	25.0	2001	25.0
1992	24.4	1993	24.4	1994	24.4	1995	24.4	1996	24.4	1997	24.4	1998	24.4	1999	24.4	2000	24.4	2001	24.4	2002	24.4
1993	23.7	1994	23.7	1995	23.7	1996	23.7	1997	23.7	1998	23.7	1999	23.7	2000	23.7	2001	23.7	2002	23.7	2003	23.7
1994	22.9	1995	22.9	1996	22.9	1997	22.9	1998	22.9	1999	22.9	2000	22.9	2001	22.9	2002	22.9	2003	22.9	2004	22.9
1995	22.1	1996	22.1	1997	22.1	1998	22.1	1999	22.1	2000	22.1	2001	22.1	2002	22.1	2003	22.1	2004	22.1	2005	22.1
1996	21.2	1997	21.2	1998	21.2	1999	21.2	2000	21.2	2001	21.2	2002	21.2	2003	21.2	2004	21.2	2005	21.2	2006	21.2
1997	20.2	1998	20.2	1999	20.2	2000	20.2	2001	20.2	2002	20.2	2003	20.2	2004	20.2	2005	20.2	2006	20.2	2007	20.2
1998	19.1	1999	19.1	2000	19.1	2001	19.1	2002	19.1	2003	19.1	2004	19.1	2005	19.1	2006	19.1	2007	19.1	2008	19.1
1999	18.0	2000	18.0	2001	18.0	2002	18.0	2003	18.0	2004	18.0	2005	18.0	2006	18.0	2007	18.0	2008	18.0	2009	18.0
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] Low altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 8.11B.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-46. NO_X Emission Factors for Low Altitude Motorcycles[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0
1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0
1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0
1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0
1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0
1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0
1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0
1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0
1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0
1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0
1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0
1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0
1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0	1998	0.0
1989	0.9	1990	0.9	1991	0.9	1992	0.9	1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9
1990	0.9	1991	0.9	1992	0.9	1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9
1991	0.9	1992	0.9	1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9
1992	0.9	1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9
1993	0.9	1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9
1994	0.9	1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9
1995	0.9	1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9
1996	0.9	1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9
1997	0.9	1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9
1998	0.9	1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9	2008	0.9
1999	0.9	2000	0.9	2001	0.9	2002	0.9	2003	0.9	2004	0.9	2005	0.9	2006	0.9	2007	0.9	2008	0.9	2009	0.9
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] Low altitude refers to a location with an altitude ≤ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 8.11C.1 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-47. VOC Emission Factors for High Altitude Motorcycles[a,b]

January 1 of Calendar Year																				
2000[c]		2001[d]		2002[d]		2003[c]		2004[d]		2005[c]		2006[d]		2007[d]		2008[c]		2009[d]		2010[c]	
MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)	MY[e]	EF[f] (g/mi)
1976	0.0	1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0
1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0
1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0
1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0
1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0
1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0
1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0
1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0
1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0
1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0
1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0
1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0
1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0	1998	0.0
1989	6.8	1990	6.8	1991	6.8	1992	6.8	1993	6.8	1994	6.8	1995	6.8	1996	6.8	1997	6.8	1998	6.8	1999	6.8
1990	6.5	1991	6.5	1992	6.5	1993	6.5	1994	6.5	1995	6.5	1996	6.5	1997	6.5	1998	6.5	1999	6.5	2000	6.5
1991	6.3	1992	6.3	1993	6.3	1994	6.3	1995	6.3	1996	6.3	1997	6.3	1998	6.3	1999	6.3	2000	6.3	2001	6.3
1992	6.1	1993	6.1	1994	6.1	1995	6.1	1996	6.1	1997	6.1	1998	6.1	1999	6.1	2000	6.1	2001	6.1	2002	6.1
1993	5.8	1994	5.8	1995	5.8	1996	5.8	1997	5.8	1998	5.8	1999	5.8	2000	5.8	2001	5.8	2002	5.8	2003	5.8
1994	5.6	1995	5.6	1996	5.6	1997	5.6	1998	5.6	1999	5.6	2000	5.6	2001	5.6	2002	5.6	2003	5.6	2004	5.6
1995	5.3	1996	5.3	1997	5.3	1998	5.3	1999	5.3	2000	5.3	2001	5.3	2002	5.3	2003	5.3	2004	5.3	2005	5.3
1996	5.0	1997	5.0	1998	5.0	1999	5.0	2000	5.0	2001	5.0	2002	5.0	2003	5.0	2004	5.0	2005	5.0	2006	5.0
1997	4.7	1998	4.7	1999	4.7	2000	4.7	2001	4.7	2002	4.7	2003	4.7	2004	4.7	2005	4.7	2006	4.7	2007	4.7
1998	4.4	1999	4.4	2000	4.4	2001	4.4	2002	4.4	2003	4.4	2004	4.4	2005	4.4	2006	4.4	2007	4.4	2008	4.4
1999	4.1	2000	4.1	2001	4.1	2002	4.1	2003	4.1	2004	4.1	2005	4.1	2006	4.1	2007	4.1	2008	4.1	2009	4.1
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] VOC emission factors are based on values for Total Non-Methane Hydrocarbons

[b] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[c] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 8.11A.2 of Appendix H to AP-42, Volume II.

[d] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[e] MY = Model Year

[f] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start; 60 to 84° F diurnal; 75° F for hot soak and running loss emissions; 9.0 psi fuel RVP; 54.57% average in-use fuel tank level, including refueling emissions.

Table 4-48. CO Emission Factors for High Altitude Motorcycles[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0
1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0
1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0
1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0
1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0
1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0
1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0
1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0
1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0
1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0
1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0
1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0
1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0	1998	0.0
1989	41.4	1990	41.4	1991	41.4	1992	41.4	1993	41.4	1994	41.4	1995	41.4	1996	41.4	1997	41.4	1998	41.4	1999	41.4
1990	41.0	1991	41.0	1992	41.0	1993	41.0	1994	41.0	1995	41.0	1996	41.0	1997	41.0	1998	41.0	1999	41.0	2000	41.0
1991	40.5	1992	40.5	1993	40.5	1994	40.5	1995	40.5	1996	40.5	1997	40.5	1998	40.5	1999	40.5	2000	40.5	2001	40.5
1992	39.9	1993	39.9	1994	39.9	1995	39.9	1996	39.9	1997	39.9	1998	39.9	1999	39.9	2000	39.9	2001	39.9	2002	39.9
1993	39.2	1994	39.2	1995	39.2	1996	39.2	1997	39.2	1998	39.2	1999	39.2	2000	39.2	2001	39.2	2002	39.2	2003	39.2
1994	38.4	1995	38.4	1996	38.4	1997	38.4	1998	38.4	1999	38.4	2000	38.4	2001	38.4	2002	38.4	2003	38.4	2004	38.4
1995	37.6	1996	37.6	1997	37.6	1998	37.6	1999	37.6	2000	37.6	2001	37.6	2002	37.6	2003	37.6	2004	37.6	2005	37.6
1996	36.7	1997	36.7	1998	36.7	1999	36.7	2000	36.7	2001	36.7	2002	36.7	2003	36.7	2004	36.7	2005	36.7	2006	36.7
1997	35.7	1998	35.7	1999	35.7	2000	35.7	2001	35.7	2002	35.7	2003	35.7	2004	35.7	2005	35.7	2006	35.7	2007	35.7
1998	34.6	1999	34.6	2000	34.6	2001	34.6	2002	34.6	2003	34.6	2004	34.6	2005	34.6	2006	34.6	2007	34.6	2008	34.6
1999	33.5	2000	33.5	2001	33.5	2002	33.5	2003	33.5	2004	33.5	2005	33.5	2006	33.5	2007	33.5	2008	33.5	2009	33.5
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] High altitude refers to a location with an altitude > 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 8.11B.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-49. NO_X Emission Factors for High Altitude Motorcycles[a]

January 1 of Calendar Year																					
2000[b]		2001[c]		2002[c]		2003[b]		2004[c]		2005[b]		2006[c]		2007[c]		2008[b]		2009[c]		2010[b]	
MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)	MY[d]	EF[e] (g/mi)
1976	0.0	1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0
1977	0.0	1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0
1978	0.0	1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0
1979	0.0	1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0
1980	0.0	1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0
1981	0.0	1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0
1982	0.0	1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0
1983	0.0	1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0
1984	0.0	1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0
1985	0.0	1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0
1986	0.0	1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0
1987	0.0	1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0
1988	0.0	1989	0.0	1990	0.0	1991	0.0	1992	0.0	1993	0.0	1994	0.0	1995	0.0	1996	0.0	1997	0.0	1998	0.0
1989	0.6	1990	0.6	1991	0.6	1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6
1990	0.6	1991	0.6	1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6
1991	0.6	1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6
1992	0.6	1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6
1993	0.6	1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6
1994	0.6	1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6
1995	0.6	1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6
1996	0.6	1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6
1997	0.6	1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6
1998	0.6	1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6	2008	0.6
1999	0.6	2000	0.6	2001	0.6	2002	0.6	2003	0.6	2004	0.6	2005	0.6	2006	0.6	2007	0.6	2008	0.6	2009	0.6
2000	0.0	2001	0.0	2002	0.0	2003	0.0	2004	0.0	2005	0.0	2006	0.0	2007	0.0	2008	0.0	2009	0.0	2010	0.0

[a] High altitude refers to a location with an altitude $\leq$ 4,000 ft above sea level.

[b] Emission factors for Calendar Years 2000, 2003, 2005, 2008 and 2010 are from Table 8.11C.2 of Appendix H to AP-42, Volume II.

[c] Emission factors for Calendar Years 2001, 2002, 2004, 2006, 2007, and 2009 were derived by AFIERA/RSEA and are expected to be accurate to +/- 0.1

[d] MY = Model Year

[e] EF = Emission Factor. This is the average grams/mile emission level for model year "MY" on January 1 of the given calendar year. These emission levels are calculated based on the following Federal Test Procedure (FTP) conditions: Speed = 19.6 mph; Temp = 75° F; Operating Mode = 20.6% of miles traveled in cold start, 52.1% in stabilized, and 27.3% in hot start.

Table 4-50. Average Emission Factors for On-Road Vehicles[a]

Vehicle Type Category	Average Emission Factors (g/mi)										
	PM (Exhaust)[b]	PM (Fugitive)[c]	PM (Total)[d]	PM_{10} (Exhaust)[b]	PM_{10} (Fugitive)[c]	PM_{10} (Total)[d]	$PM_{2.5}$ (Exhaust)[b]	$PM_{2.5}$ (Fugitive)[c]	$PM_{2.5}$ (Total)[d]	SO_X	Lead
LDGV	0.011	3.59	3.60	0.011	0.70	0.71	0.010	0.19	0.20	0.072	0.0015
LDGT1	0.013	5.51	5.53	0.013	1.06	1.08	0.012	0.28	0.29	0.096	0.0020
LDGT2	0.013	13.42	13.43	0.013	2.57	2.58	0.012	0.65	0.66	0.098	0.0021
HDGV	0.068	28.56	28.62	0.066	5.44	5.51	0.061	1.36	1.42	0.154	0.0033
LDDV	0.100	3.59	3.69	0.100	0.70	0.80	0.092	0.19	0.28	0.116	Neg
LDDT	0.109	7.70	7.80	0.109	1.48	1.59	0.100	0.38	0.48	0.157	Neg
HDDV	0.124	39.90	40.03	0.124	7.60	7.73	0.114	1.90	2.01	0.512	Neg
MC	0.003	0.34	0.34	0.003	0.08	0.08	0.003	0.03	0.03	0.032	0.0012

[a] Average emission factors were derived by AFIERA/RSEA based on estimated average/typical parameters for each vehicle type category.

[b] Exhaust emission factors for diesel vehicles (i.e., LDDV, LDDT, and HDDV categories) are considered conservatively high since they are based on use of high sulfur fuel.

[c] Fugitive emissions are based on "on-road" travel.

[d] Total emissions are the sum of the Exhaust and Fugitive emissions.

Neg = Negligible

Table 4-51. Default Fuel Economies for On-Road Vehicles[a]

Vehicle Type Category	Default Fuel Economy (mpg)
LDGV	22.64
LDGT1	16.87
LDGT2	16.58
HDGV	10.52
LDDV	27.17
LDDT	20.07
HDDV	6.17
MC	50.00

[a] Values are from Appenix B of Reference 3. The values are those listed for Model Year 1995.

Table 4-52. Default Carbon Emission Factors for On-Road Gasoline Vehicles

Vehicle Type Category	Model Years	Default Carbon Emission Factor (g/mi)[a]
LDGV	1975 - 1980	0.0155[b]
	1981+	0.0043
LDGT1	1975 - 1986	0.0155[b]
	1987+	0.0043
LDGT2	1979 - 1986	0.0155[b]
	1987+	0.0043
HDGV	All	0.0540
MC	All	Negligible

[a] Emission factors are from Table 1 of the Appendix to the Users Manual for the EPA's PART5 Computer Program. The values are for vehicles with catalyst using unleaded fuel.

[b] Value is an average of the emission factors for "no-air" catalyst vehicles and "air" catalyst vehicles.

Table 4-53. Exhaust PM Emission Factors for On-Road Diesel Vehicles

Vehicle Type Category	Model Years	Exhaust PM Emission Factor (g/mi)[a]
LDDV	pre-1981	0.677
	1981	0.236
	1982 - 1986	0.232
	1987 - 1995	0.110
	1996+	0.100
LDDT	pre-1981	0.672
	1981	0.281
	1982 - 1986	0.328
	1987	0.306
	1988 - 1993	0.264
	1994 - 1996	0.130
	1997+	0.109
HDDV[b]	pre-1988	1.50
	1988 - 1990	0.963
	1991 - 1993	0.500
	1994+	0.213

[a] Emission factors were calculated using the EPA's PART5 Computer Program.

[b] Emission factors for HDDV are based on values for "Medium Heavy Duty Vehicles."

Table 4-54. Estimated Average Weights of Vehicles by Vehicle Category

Vehicle Type Category	Category Weight Range (lb)	Estimated Average Vehicle Weight[a]	
		(lb)	(ton)
LDGV	≤ 6,000	3,000	1.5
LDGT1	≤ 6,000	4,000	2.0
LDGT2	6,001 - 8,500	7,250	3.6
HDGV	> 8,500	12,000	6.0
LDDV	≤ 6,000	3,000	1.5
LDDT	≤ 8,500	5,000	2.5
HDDV	> 8,500	15,000	7.5
MC	-----	600	0.3

[a] These values were arbitrary estimates by AFIERA/RSEA for purposes of calculating average PM emission factors associated with fugitive road dust.

Table 4-55. Typical Silt Content Values for Unpaved Roads

Location or Road Type	Road Use or Surface Material	Mean Silt Content (%)
Publicly Accessible Roads	Gravel/crushed limestone	6.4
	Dirt (i.e., local material compacted, bladed, and crowned)	11
Construction Sites	Scraper Routes	8.5
Municipal Solid Waste Landfills	Disposal Routes	6.4

Table 4-56. PM_{10} and $PM_{2.5}$ Fractions for Various Sources of On-Road Vehicle PM Emissions

Source	PM_{10} to PM Fraction[a]	$PM_{2.5}$ to PM Fraction[b]
Exhaust from Gasoline Vehicles[c]	0.97	0.9[d]
Exhaust from Diesel Vehicles	1.00	0.92
Break Wear	0.98	0.8[e]
Tire Wear	1.00	1.00[f]
Road Dust (Paved Roads)	0.19	0.047
Road Dust (Unpaved Roads)	0.36	0.095

[a] This is the fraction of Total PM which is less than or equal to 10 microns.

[b] This is the fraction of Total PM which is less than or equal to 2.5 microns.

[c] Refers to gasoline vehicles with catalyst using unleaded fuel.

[d] No specific value was listed for $PM_{2.5}$. However, based on values listed for other sizes, the $PM_{2.5}$ fraction should be "0.9" rounded to the nearest tenth.

[e] No specific value was listed for $PM_{2.5}$. Therefore, the value listed for $PM_{4.7}$ (rounded to the nearest tenth) is conservatively provided.

[f] No specific value was listed for $PM_{2.5}$. Therefore, the value listed for PM_{10} is conservatively provided.

Table 4-57. Benzene Emission Factors for On-Road Vehicles (Revised December 2003)

Calendar Year[a]	Emission Factors by Vehicle Type Category (mg/mi)[b]							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
2000	42.53	51.50	74.16	123.73	12.22	20.20	14.56	83.78
2001	39.67	48.10	70.10	114.34	11.11	18.82	13.82	82.52
2002	36.82	44.69	66.03	104.96	10.00	17.44	13.08	81.26
2003	33.96	41.29	61.97	95.57	8.89	16.06	12.34	80.00
2004	31.11	37.88	57.91	86.18	7.78	14.68	11.60	78.74
2005	28.26	34.47	53.85	76.79	6.66	13.29	10.86	77.49
2006	25.40	31.07	49.79	67.41	5.55	11.91	10.12	76.23
2007	22.55	27.66	45.73	58.02	4.44	10.53	9.38	74.97
2008	21.94	26.92	45.08	55.84	4.26	10.52	9.29	74.97
2009	21.33	26.18	44.42	53.67	4.08	10.52	9.21	74.98
2010	20.72	25.45	43.77	51.49	3.90	10.51	9.12	74.98

[a] Emission factors for calendar year 2007 were taken directly from Reference 8. Emission factors for all other calendar years were extrapolated by AFIERE/RSEQ based on values listed in Reference 8 for calendar years 1996, 2007, and 2020.

[b] Emission factors are in units of grams pollutant per vehicle miles traveled (g/mi), and are based on U.S. annual average baseline values.

Table 4-58. Acetaldehyde Emission Factors for On-Road Vehicles (Revised December 2003)

Calendar Year[a]	Emission Factors by Vehicle Type Category (mg/mi)[b]							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
2000	4.62	5.99	9.60	24.22	7.52	12.43	39.94	18.47
2001	4.27	5.52	8.91	22.09	6.83	11.58	37.91	18.38
2002	3.91	5.05	8.21	19.95	6.15	10.72	35.88	18.29
2003	3.56	4.58	7.52	17.82	5.46	9.87	33.85	18.20
2004	3.20	4.11	6.83	15.69	4.78	9.02	31.82	18.11
2005	2.84	3.64	6.14	13.56	4.10	8.17	29.79	18.01
2006	2.49	3.17	5.44	11.43	3.41	7.32	27.76	17.92
2007	2.13	2.70	4.75	9.30	2.73	6.47	25.73	17.83
2008	2.07	2.62	4.66	8.86	2.62	6.47	25.49	17.83
2009	2.00	2.54	4.58	8.42	2.51	6.46	25.25	17.83
2010	1.94	2.46	4.49	7.98	2.40	6.46	25.01	17.83

[a] Emission factors for calendar year 2007 were taken directly from Reference 8. Emission factors for all other calendar years were extrapolated by AFIERE/RSEQ based on values listed in Reference 8 for calendar years 1996, 2007, and 2020.

[b] Emission factors are in units of grams pollutant per vehicle miles traveled (g/mi), and are based on U.S. annual average baseline values.

Table 4-59. Formaldehyde Emission Factors for On-Road Vehicles (Revised December 2003)

Calendar Year[a]	Emission Factors by Vehicle Type Category (mg/mi)[b]							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
2000	11.95	16.47	27.62	110.47	23.59	38.99	108.44	65.18
2001	10.87	14.94	25.15	99.38	21.44	36.32	102.93	64.33
2002	9.79	13.42	22.67	88.29	19.30	33.66	97.41	63.47
2003	8.71	11.89	20.20	77.20	17.15	30.99	91.90	62.62
2004	7.63	10.36	17.72	66.11	15.00	28.32	86.39	61.76
2005	6.56	8.83	15.24	55.02	12.85	25.65	80.88	60.91
2006	5.48	7.30	12.77	43.93	10.71	22.99	75.36	60.05
2007	4.40	5.77	10.29	32.84	8.56	20.32	69.85	59.20
2008	4.27	5.60	10.07	31.16	8.22	20.31	69.20	59.19
2009	4.15	5.42	9.85	29.48	7.87	20.30	68.55	59.18
2010	4.02	5.25	9.63	27.79	7.53	20.28	67.90	59.17

[a] Emission factors for calendar year 2007 were taken directly from Reference 8. Emission factors for all other calendar years were extrapolated by AFIERE/RSEQ based on values listed in Reference 8 for calendar years 1996, 2007, and 2020.

[b] Emission factors are in units of grams pollutant per vehicle miles traveled (g/mi), and are based on U.S. annual average baseline values.

Table 4-60. 1,3-Butadiene Emission Factors for On-Road Vehicles (Revised December 2003)

Calendar Year[a]	Emission Factors by Vehicle Type Category (mg/mi)[b]							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
2000	4.99	6.22	10.39	20.98	5.50	9.09	8.46	25.15
2001	4.66	5.83	9.71	18.76	5.00	8.47	8.03	24.87
2002	4.33	5.44	9.02	16.55	4.49	7.85	7.60	24.60
2003	4.00	5.05	8.34	14.33	3.99	7.23	7.17	24.32
2004	3.67	4.66	7.65	12.11	3.49	6.61	6.74	24.04
2005	3.33	4.28	6.97	9.89	2.99	5.98	6.31	23.76
2006	3.00	3.89	6.28	7.68	2.49	5.36	5.88	23.48
2007	2.67	3.50	5.60	5.46	1.99	4.74	5.45	23.20
2008	2.62	3.42	5.54	5.16	1.91	4.74	5.40	23.20
2009	2.56	3.34	5.48	4.86	1.83	4.73	5.35	23.20
2010	2.51	3.26	5.43	4.56	1.75	4.73	5.30	23.19

[a] Emission factors for calendar year 2007 were taken directly from Reference 8. Emission factors for all other calendar years were extrapolated by AFIERE/RSEQ based on values listed in Reference 8 for calendar years 1996, 2007, and 2020.

[b] Emission factors are in units of grams pollutant per vehicle miles traveled (g/mi), and are based on U.S. annual average baseline values.

Table 4-61. MTBE Emission Factors for On-Road Vehicles[a] (Revised December 2003)

Calendar Year[b]	Emission Factors by Vehicle Type Category (mg/mi)[c]							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
2000	16.48	18.98	22.32	43.36	0.00	0.00	0.00	66.52
2001	15.00	17.19	20.59	39.79	0.00	0.00	0.00	63.12
2002	13.53	15.39	18.87	36.21	0.00	0.00	0.00	59.72
2003	12.05	13.60	17.14	32.64	0.00	0.00	0.00	56.32
2004	10.58	11.81	15.41	29.06	0.00	0.00	0.00	52.92
2005	9.11	10.02	13.68	25.49	0.00	0.00	0.00	49.53
2006	7.63	8.23	11.95	21.91	0.00	0.00	0.00	46.13
2007	6.16	6.44	10.22	18.34	0.00	0.00	0.00	42.73
2008	5.97	6.22	9.88	17.95	0.00	0.00	0.00	42.69
2009	5.79	6.00	9.54	17.57	0.00	0.00	0.00	42.65
2010	5.60	5.78	9.20	17.18	0.00	0.00	0.00	42.61

[a] MTBE = Methyl tert-butyl ether

[b] Emission factors for calendar year 2007 were taken directly from Reference 8. Emission factors for all other calendar years were extrapolated by AFIERE/RSEQ based on values listed in Reference 8 for calendar years 1996, 2007, and 2020.

[c] Emission factors are in units of grams pollutant per vehicle miles traveled (g/mi), and are based on U.S. annual average baseline values.

Table 4-62. Idling Emission Factors for On-Road Vehicles during Winter Conditions[a]

Vehicle Type Category	Emission Factors (g/hr)			
	CO	NO_X	PM_{10}	VOC
LDGV	371	6.16	ND	21.1
LDGT	487	7.47	ND	30.7
HDGV	682	11.8	ND	44.6
LDDV	10.1	6.66	ND	3.63
LDDT	11.5	6.89	ND	4.79
HDDV	94.6	56.7	2.59	12.6
MC	388	2.51	ND	20.1

[a] Winter conditions are based on a temperature of 30° F and gasoline with a RVP of 13 psi.
ND = No data

Table 4-63. Idling Emission Factors for On-Road Vehicles during Summer Conditions[a]

Vehicle Type Category	Emission Factors (g/hr)			
	CO	NO_X	PM_{10}	VOC
LDGV	229	4.72	ND	16.1
LDGT	339	5.71	ND	24.1
HDGV	738	10.2	ND	35.8
LDDV	9.97	6.5	ND	3.53
LDDT	11.2	6.67	ND	4.63
HDDV	94	55	2.59	12.5
MC	435	1.69	ND	19.4

[a] Summer conditions are based on a temperature of 75° F and gasoline with a RVP of 9 psi.
ND = No data

Table 4-64. Average Idling Emission Factors for On-Road Vehicles[a]

Vehicle Type Category	Emission Factors (g/hr)			
	CO	NO_X	PM_{10}	VOC
LDGV	300	5.4	ND	18.6
LDGT	413	6.6	ND	27.4
HDGV	710	11.0	ND	40.2
LDDV	10.0	6.6	ND	3.6
LDDT	11.4	6.8	ND	4.7
HDDV	94.3	55.9	2.59	12.6
MC	412	2.1	ND	19.8

[a] Values in this table are an average of the values listed in Tables 4-62 and 4-63.

ND = No data

4.5 References

1. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors – Volume II: Mobile Sources* (AP-42, Volume II), Pending 5th Edition, Appendix H, April 1998.

2. U.S. Environmental Protection Agency, *Draft User's Guide to PART5: A Program for Calculating Particle Emissions from Motor Vehicles*, EPA-AA-AQAB-94-2, February 1995.

3. Emissions Inventory Improvement Program (EIIP), *Volume IV: Chapter 1, "Preferred and Alternative Methods for Gathering and Locating Specific Emissions Inventory Data,"* June 1996.

4. U.S. Environmental Protection Agency, *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources,* EPA420-R-92-009, December 1992.

5. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors – Volume I: Stationary Point and Area Sources* (AP-42, Volume I), Section 13.2.1, October 1997.

6. U.S. Environmental Protection Agency, *Addendum to Emission Factor Documentation for AP-42 Section 11.2.5 and 11.2.6 (Now 13.2.1)*, September 1997.

7. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors – Volume I: Stationary Point and Area Sources* (AP-42, Volume I), Section 13.2.2, September 1998.

8. U.S. Environmental Protection Agency, *Analysis of the Impacts of Control Programs on Motor Vehicle Toxics Emissions and Exposure in Urban Areas and Nationwide: Volume II: Detailed Toxics Emissions and Exposure Estimates*, EPA420-R-99-030, November 1999.

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SECTION 5

ON-ROAD VEHICLES – GOVERNMENT OWNED

5.1 Background: Government owned vehicles (GOVs) include all on-road vehicles which are owned/operated by government organizations on base (e.g., Air Force, Guard, Reserve, etc). These vehicles are usually referred to as "Fleet Vehicles" and typically range from small passenger cars to large trucks (e.g., refueling trucks, fire trucks, cargo trucks, etc.). Most government owned vehicles fall under one of the vehicle type categories listed in Section 4.1. It's important to note, however, that due to Energy Policy Act (EPACT) requirements, as well as increasingly stringent air quality regulations, some Air Force installations have converted a portion of their fleet to alternative fuel vehicles. The most common alternative fuels currently available include compressed natural gas (CNG), propane (also referred to as liquefied petroleum gas (LPG)), ethanol, and methanol. Most, if not all, alternative fuel vehicles in the Air Force are CNG vehicles.

5.2 Emission Calculations: Emissions from GOVs are calculated using the general methodologies, equations, and emission factors specified in Section 4. In summary, emissions from on-road vehicles (including government owned vehicles) are calculated by multiplying the estimated vehicle miles traveled (on the installation) times applicable EPA emission factors. Separate calculations are performed for each vehicle category (LDGV, LDGT1, LDDV, etc.) and the results are added together to get the total pollutant emissions. For GOVs, the following equation is used:

$$E_{GOV,pol} = [(VMT_{GOV,LDGV} * EF_{LDGV}) + (VMT_{GOV,LDGT1} * EF_{LDGT1}) + (VMT_{GOV,LDGT2} * EF_{LDGT2}) + (VMT_{GOV,HDGV} * EF_{HDGV}) + (VMT_{GOV,LDDV} * EF_{LDDV}) + (VMT_{GOV,LDDT} * EF_{LDDT}) + (VMT_{GOV,HDDV} * EF_{HDDV}) + (VMT_{GOV,MC} * EF_{MC})] * 0.002205$$

Where,

$E_{GOV,pol}$ = Emissions of a particular pollutant generated by GOVs (lb/yr)
$VMT_{GOV,XXXX}$ = Estimated vehicle miles traveled on the installation by GOVs belonging to vehicle category XXXX (miles/yr)
EF_{XXXX} = Applicable pollutant emission factor for vehicle category XXXX (grams/mile) [note – for several pollutants this will be dependent on the vehicle model year]
0.002205 = Factor to convert grams to pounds (lb/gram)

Applicable emission factors for calculating emissions from GOVs are provided in Section 4. Since many of these emission factors are dependent on the vehicle model year (MY), the individual(s) responsible for preparing the mobile source air emissions inventory must make a decision as to how comprehensive/accurate they want the inventory to be. Although many GOVs are relatively new vehicles, the number of different model years represented in an installation's fleet of GOVs may be fairly high (i.e., typically >10). Therefore, attempting to calculate emissions for each different model year may be extremely labor intensive, and in most cases, not

feasible. A more common and practical approach for calculating emissions from GOVs is to use an average model year for each applicable vehicle category (LDGV, LDGT1, LDDV, etc.). First, the GOVs are separated by their vehicle category. Second, the miles driven during the year by all vehicles in a vehicle category are added together to obtain the total miles for that specific vehicle category (note - this step is repeated for each different vehicle category). Next, the average model year is then estimated for each vehicle category. Finally, pollutant emissions are calculated using the equation above.

It's important to note that calculating government owned vehicle emissions using the average model year for each vehicle category is just a recommendation. If more accurate calculations are necessary and adequate resources (manpower, time, money, etc.) are available, then calculations can be done for each different model year. This would involve establishing groups based on both vehicle category and model year (instead of just vehicle category). For example, Light Duty Gasoline Vehicles that are model year 1997 ($LDGV_{1997}$) would be one group, $LDGV_{1998}$ would be another group, $LDGT1_{1997}$ another, etc. After every group is identified, the total miles driven by vehicles in each group are calculated. Emissions of a particular pollutant are then calculated for each individual group and the results added together to obtain the total emissions. The following equation is used:

$$E_{pol} = [(VMT_{Group1} * EF_{Group1}) + (VMT_{Group2} * EF_{Group}) + (VMT_{Group3} * EF_{Group3}) + (VMT_{Group4} * EF_{Group4}) + (VMT_{Group5} * EF_{Group5}) + \ldots \text{ etc.}] * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
$VMT_{Group\#}$ = Estimated vehicle miles traveled during the year by vehicles in Group # (miles/yr)
$EF_{Group\#}$ = Pollutant emission factor applicable to vehicles in Group # (grams/mile)
0.002205 = Factor to convert grams to pounds (lb/gram)

A compromise between using the average model year versus each different model year is to use groups of model years. Basically, vehicles under each vehicle category (LDGV, LDGT1, LDDV, etc.) would be placed in 3 or 5 year model year groups. For example, using a 5 year grouping system, Light Duty Gasoline Vehicles that have a 1991 through 1995 model year ($LDGV_{1991\text{-}1995}$) could be one group, $LDGV_{1996\text{-}2000}$ would be another group, $LDGT1_{1991\text{-}1995}$ another, etc. After the groups are established, emissions are then calculated in the same manner specified above for each different model year. In regards to emission factors, values listed for the middle year of the model year group could be used. As an example, for a 1991-1995 model year group emissions could be calculated using emission factors for model year 1993.

Prior to performing any calculations, necessary data on base GOVs must be collected. If possible, data should be collected on each individual GOV on the installation. The data should include the following items: vehicle category (LDGV, LDGT1, LDDV, etc.), vehicle identification, model year, and miles driven during the year. It's important to note that miles driven should only include the miles driven on the installation. Therefore, if any GOVs are

driven off the installation, then an estimate must be made as to how many of the total miles driven during the year were actually driven on the installation. The best way to collect this data is to provide data collection forms to those organizations responsible for GOVs. Figures 5-1 through 5-7 provide examples of data collection forms for each vehicle category (except motorcycles which are usually not part of an Air Force installation's GOV inventory).

5.2.1 Idling Vehicles: As mentioned in section 4.2.4 of this report, there may be some vehicles on an Air Force installation (including some GOVs) which typically spend a large amount of time operating in the idle mode, as opposed to actually being driven. For these vehicles, AFIERA/RSEA recommends calculating the idle emissions separately (using the procedures specified in section 4.2.4) and then adding the idling emissions (for each pollutant) to the emissions calculated based on vehicle miles traveled.

5.2.2 Alternative Fuel Vehicles: As mentioned in section 5.1 above, some Air Force installations now have government owned vehicles which run on an alternative fuel, typically compressed natural gas (CNG). Emissions from CNG and other alternative fuel vehicles are calculated in the same manner as gasoline and diesel vehicles (i.e., based on vehicle miles traveled and "g/mi" emission factors). Most emission values associated with alternative fuel vehicles are specific to the vehicle make/model and model year. Due to the vast number of test studies and emission results available, AFIERA/RSEA recommends contacting one or more of the following agencies/organizations if specific emission factors are desired:

Applicable Vehicle Manufacturer
(note – the phone numbers and addresses for the manufacturer should be provided in the vehicle owner's manual, and may also be found on the manufacturer's website)

U.S. Environmental Protection Agency
Office of Transportation and Air Quality
Alternative Fuel Vehicle Section
Tel: 734-214-4223

U.S. Department of Energy
Office of Transportation Technologies
Alternative Fuels Data Center
Tel: (800) 423-1363
E-mail: hotline@afdc.nrel.gov
URL: http://www.afdc.doe.gov/

The Natural Gas Vehicle Coalition
Tel: 703-527-3022
Fax: 703-527-3025
URL: http://www.ngvc.org/

In some cases, emission factors for specific types of alternative fuel vehicles are not available or are not needed. In these cases, AFIERA recommends using one of the following two options to obtain estimated emission factors for alternative fuel vehicles:

Option 1 – According to a Fact Sheet written by the North Carolina Division of Air Quality, CNG powered vehicles typically emit approximately 74% less CO, 85% less NO_X, and 70% less VOC than similar gasoline powered vehicles. Therefore, emission factors for CNG vehicles can be estimated by multiplying the emission factors for corresponding gasoline vehicles times the following factors: 0.26 for CO, 0.15 for NO_X, and 0.30 for VOC. As an example, a base located in a "low altitude" area has a Model Year 1999 CNG-fueled Light Duty Truck with a GVW of 5,500 lb. The base is unable to find any specific emission factors for the type of CNG vehicle they have, and therefore, would like to use estimated emission factors for their CY 2000 emissions inventory. According to Tables 4-8 through 4-10 of this document, emission factors for low altitude Model Year 1999 LDGT1 vehicles on 1 January 2001 are as follows: 0.4 g/mi for VOC, 6.8 g/mi for CO, and 0.5 g/mi for NO_X. Based on these values, the estimated emission factors for their CNG-fueled truck are as follows:

VOC Emission Factor = 0.4 g/mi * 0.30 = 0.12 g/mi
CO Emission Factor = 6.8 g/mi * 0.26 = 1.77 g/mi
NO_X Emission Factor = 0.5 g/mi * 0.15 = 0.075 g/mi

Option 2 – The U.S. EPA has issued a variety of emission standards for clean-fuel vehicles. These standards are found in Title 40 Code of Federal Regulations, Part 88 (40 CFR 88) and are applicable to vehicles with a model year of 1994 or later. These standards could be used as emission factors for applicable alternative fuel vehicles (i.e., CNG and/or LPG vehicles) at the installation.

5.3 Information Resources: Information required to calculate emissions from GOVs can usually be obtained from base Transportation. The base Transportation organization typically maintains records on most, if not all, GOVs assigned to the installation. At some installations it might be necessary to obtain some information directly from the shops/organizations who actually use and/or maintain the vehicles. For example, the Fire Department may need to be contacted to obtain information on Fire Trucks and other rescue vehicles. Likewise, the base Fuels Flight may need to be contacted for information on refueling trucks. Finally, the base Weather Detachment should be contacted to obtain the installation's altitude (feet above sea level). The altitude is needed to determine whether the installation is at a low altitude location (i.e., $\leq$ 4,000 ft above sea level) or a high altitude location (> 4,000 feet above sea level).

5.4 Example Calculations: A small Air Force installation has a requirement to inventory the calendar year 2000 emissions from their government owned vehicles. The Transportation shop on the installation was contacted and stated only 17 government vehicles were used during the previous calendar year. Forms similar to those shown in Figures 5-1 to 5-7 were given to the Transportation shop to be completed. A summary of the information provided on the forms is shown on the next page.

Vehicle Identification	Description	Model Year	Estimated Miles Driven During CY 2000*
LDGV			
Vehicle 9	Station Wagon	1996	1,100
Vehicle 10	Sedan	1997	2,900
Vehicle 15	Sedan	1999	3,500
Vehicle 17	Sedan	2000	3,200
	Average	**1998**	
	Total		**10,700**
LDGT1			
Vehicle 6	Full-Size Van	1995	4,600
Vehicle 12	Pickup Truck	1997	5,200
Vehicle 14	Pickup Truck	1998	6,400
Vehicle 16	SUV	1999	3,800
	Average	**1997**	
	Total		**20,000**
LDGT2			
Vehicle 13	Pickup Truck	1997	4,700
	Average	**1997**	
	Total		**4,700**
HDGV			
Vehicle 5	Flatbed Truck	1995	1,400
Vehicle 11	Flatbed Truck	1997	1,700
	Average	**1996**	
	Total		**3,100**
LDDV			
Vehicle 4	Sedan	1995	1,800
	Average	**1995**	
	Total		**1,800**
LDDT			
Vehicle 7	Pickup Truck	1996	3,000
Vehicle 8	Pickup Truck	1996	2,600
	Average	**1996**	
	Total		**5,600**
HDDV			
Vehicle 1	Fire Truck	1992	900
Vehicle 2	Refueling Truck	1993	2,300
Vehicle 3	Small Cargo Truck	1994	1,900
	Average	**1993**	
	Total		**5,100**

*Estimate only includes miles driven on the installation

Using the information provided by the Transportation shop, calculate the CY 2000 emissions of carbon monoxide.

Step 1 – The first step is to contact the Weather Detachment to obtain the installation's altitude. According to the Weather Detachment, the installation is approximately 2,200 feet above sea level. Since the altitude is less than 4,000 feet above sea level, the installation is considered to be in a low altitude location.

Step 2 – The second step is to identify the applicable emissions factors based on vehicle category, average model year, the fact the installation is at a low altitude location, and the fact the inventory is for calendar year 2000. A review of the emission factors listed in Section 4 reveals the following applicable emission factors:

Vehicle Category	Average Model Year	CO Emission Factor* (grams/mile)
LDGV	1998	6.2
LDGT1	1997	12.0
LDGT2	1997	12.8
HDGV	1996	16.7
LDDV	1995	1.5
LDDT	1996	1.7
HDDV	1993	11.5

*Emission factors are based on values listed for January 1, 2001.

Step 3 – The third and final step is to calculate the CO emissions using the applicable emission factors and miles traveled:

$$E_{GOV,pol} = [(VMT_{GOV,LDGV} * EF_{LDGV}) + (VMT_{GOV,LDGT1} * EF_{LDGT1}) + (VMT_{GOV,LDGT2} * EF_{LDGT2}) + (VMT_{GOV,HDGV} * EF_{HDGV}) + (VMT_{GOV,LDDV} * EF_{LDDV}) + (VMT_{GOV,LDDT} * EF_{LDDT}) + (VMT_{GOV,HDDV} * EF_{HDDV}) + (VMT_{GOV,MC} * EF_{MC})] * 0.002205$$

$$E_{GOV,CO} = [(10{,}700 \text{ miles/yr} * 6.2 \text{ grams/mile}) + (20{,}000 \text{ miles/yr} * 12.0 \text{ grams/mile}) + (4{,}700 \text{ miles/yr} * 12.8 \text{ grams/mile}) + (3{,}100 \text{ miles/yr} * 16.7 \text{ grams/mile}) + (1{,}800 \text{ miles/yr} * 1.5 \text{ grams/mile}) + (5{,}600 \text{ miles/yr} * 1.7 \text{ grams/mile}) + (5{,}100 \text{ miles/yr} * 11.5 \text{ grams/mile})] * 0.002205$$

$$E_{GOV,CO} = [66{,}340 \text{ grams/yr} + 240{,}000 \text{ grams/yr} + 60{,}160 \text{ grams/yr} + 51{,}770 \text{ grams/yr} + 2{,}700 \text{ grams/yr} + 9{,}520 \text{ grams/yr} + 58{,}650 \text{ grams/yr}] * 0.002205 = \mathbf{1{,}079 \text{ lb/yr}}$$

Figure 5-1. Example Data Collection Form for Government Owned Vehicles (LDGV Category)[1]

Installation Name: **Inventory Year (CY):**

Responsible Organization (Name & Office Symbol):

POC (Name & Phone #):

Vehicle Category: Light Duty Gasoline Vehicles (LDGV)[1] [see note 1 below for definition]

Vehicle Identification Number (VIN)[2]	Vehicle Description[3]	Bldg No.[4]	Model Year	Miles Driven During the Inventory Year (mi/yr)[5]
		Average Model Year		
		Total Miles Driven on the Installation During the CY		

Notes

[1] LDGV includes all gasoline passenger cars [note - does not include SUVs, vans, or pickup trucks].

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

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Figure 5-2. Example Data Collection Form for Government Owned Vehicles (LDGT1 Category)[1]

Installation Name: **Inventory Year (CY):**

Responsible Organization (Name & Office Symbol):

POC (Name & Phone #):

Vehicle Category: Light Duty Gasoline-Fueled Trucks, Type 1 (LDGT1)[1] [see note 1 below for definition]

Vehicle Identification Number (VIN)[2]	Vehicle Description[3]	Bldg No.[4]	Model Year	Miles Driven During the Inventory Year (mi/yr)[5]
		Average Model Year		
		Total Miles Driven on the Installation During the CY		

Notes

[1] LDGT1 includes gasoline pickup trucks, sport utility vehicles (SUVs), and vans with a GVW of 6,000 pounds or less

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

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Figure 5-3. Example Data Collection Form for Government Owned Vehicles (LDGT2 Category)[1]

Installation Name:		**Inventory Year (CY):**		
Responsible Organization (Name & Office Symbol):				
POC (Name & Phone #):				
Vehicle Category: Light Duty Gasoline-Fueled Trucks, Type 2 (LDGT2)[1] [see note 1 below for definition]				
Vehicle Identification Number (VIN)[2]	**Vehicle Description[3]**	**Bldg No.[4]**	**Model Year**	**Miles Driven During the Inventory Year (mi/yr)[5]**
		Average Model Year		
		Total Miles Driven on the Installation During the CY		

Notes

[1] LDGT2 includes gasoline trucks (including pickups), SUVs, vans, and buses with a GVW between 6,001 - 8,500 pounds

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

Figure 5-4. Example Data Collection Form for Government Owned Vehicles (HDGV Category)[1]

Installation Name:		**Inventory Year (CY):**		
Responsible Organization (Name & Office Symbol):				
POC (Name & Phone #):				
Vehicle Category: Heavy Duty Gasoline Vehicles (HDGV)[1] [see note 1 below for definition]				
Vehicle Identification Number (VIN)[2]	**Vehicle Description[3]**	**Bldg No.[4]**	**Model Year**	**Miles Driven During the Inventory Year (mi/yr)[5]**
		Average Model Year		
		Total Miles Driven on the Installation During the CY		

Notes

[1] HDGV includes all gasoline vehicles with a GVW exceeding 8,500 pounds.

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

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Figure 5-5. Example Data Collection Form for Government Owned Vehicles (LDDV Category)[1]

Installation Name: **Inventory Year (CY):**

Responsible Organization (Name & Office Symbol):

POC (Name & Phone #):

Vehicle Category: Light Duty Diesel Vehicles (LDDV)[1] [see note 1 below for definition]

Vehicle Identification Number (VIN)[2]	Vehicle Description[3]	Bldg No.[4]	Model Year	Miles Driven During the Inventory Year (mi/yr)[5]
		Average Model Year		
		Total Miles Driven on the Installation During the CY		

Notes

[1] LDDV includes all diesel passenger cars [note - does not include SUVs, vans, or pickup trucks].

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

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Figure 5-6. Example Data Collection Form for Government Owned Vehicles (LDDT Category)[1]

Installation Name:		**Inventory Year (CY):**		
Responsible Organization (Name & Office Symbol):				
POC (Name & Phone #):				
Vehicle Category: Light Duty Diesel Trucks (LDDT)[1] [see note 1 below for definition]				
Vehicle Identification Number (VIN)[2]	**Vehicle Description[3]**	**Bldg No.[4]**	**Model Year**	**Miles Driven During the Inventory Year (mi/yr)[5]**
		Average Model Year		
		Total Miles Driven on the Installation During the CY		

Notes

[1] LDDT includes diesel trucks (including pickups), SUVs, vans, and buses with a GVW of 8,500 pounds or less

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

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Figure 5-7. Example Data Collection Form for Government Owned Vehicles (HDDV Category)[1]

Installation Name:			**Inventory Year (CY):**	
Responsible Organization (Name & Office Symbol):				
POC (Name & Phone #):				
Vehicle Category: Heavy Duty Diesel Vehicles (HDDV)[1] [see note 1 below for definition]				
Vehicle Identification Number (VIN)[2]	**Vehicle Description[3]**	**Bldg No.[4]**	**Model Year**	**Miles Driven During the Inventory Year (mi/yr)[5]**
Average Model Year				
Total Miles Driven on the Installation During the CY				

Notes

[1] HDDV includes diesel trucks and buses with a GVW exceeding 8,500 pounds.

[2] If the VIN is not available, please provide some other designation which is unique to the vehicle.

[3] Examples include sedan, hatchback, station wagon, etc.

[4] This is the primary location the vehicle was assigned to (kept at) during the inventory year.

[5] Only include miles driven on the installation [note - if unknown, provide best estimate possible (to nearest 100 miles)].

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5.5 References

1. Title 40 Code of Federal Regulations Part 88 (40 CFR 88), *Clean-Fuel Vehicles.*

2. State of North Carolina, Division of Air Quality, Mobile Source Compliance Branch, Fact Sheet titled: *CNG Fueled Vehicles.*

SECTION 6

ON-ROAD VEHICLES – PRIVATELY OWNED

6.1 Background: Privately owned vehicles (POVs) include those on-road vehicles which travel on an Air Force installation, but are not owned/operated by the government. Most POVs are vehicles owned and operated by base employees, visitors, and contractors. POVs typically cover every vehicle category, ranging from motorcycles to large trucks (e.g., refueling trucks, fire trucks, cargo trucks, etc.). A list of the different vehicle type categories applicable to POVs is provided in Section 4.1.

6.2 Emission Calculations: Emissions from POVs are calculated using the general methodologies, equations, and emission factors specified in Section 4. In summary, emissions from on-road vehicles (including privately owned vehicles) are calculated by multiplying the estimated vehicle miles traveled (on the installation) times applicable EPA emission factors. Separate calculations are performed for each vehicle category (LDGV, LDGT1, LDDV, etc.) and the results are added together to get the total pollutant emissions. For POVs, the following equation is used:

$$E_{POV,pol} = [(VMT_{POV,LDGV} * EF_{LDGV}) + (VMT_{POV,LDGT1} * EF_{LDGT1}) + (VMT_{POV,LDGT2} * EF_{LDGT2}) + (VMT_{POV,HDGV} * EF_{HDGV}) + (VMT_{POV,LDDV} * EF_{LDDV}) + (VMT_{POV,LDDT} * EF_{LDDT}) + (VMT_{POV,HDDV} * EF_{HDDV}) + (VMT_{POV,MC} * EF_{MC})] * 0.002205$$

Where,

$E_{POV,pol}$ = Emissions of a particular pollutant generated by POVs (lb/yr)
$VMT_{POV,XXXX}$ = Estimated vehicle miles traveled on the installation by POVs belonging to vehicle category XXXX (miles/yr)
EF_{XXXX} = Applicable pollutant emission factor for vehicle category XXXX (grams/mile) [note – for several pollutants this will be dependent on the vehicle model year]
0.002205 = Factor to convert grams to pounds (lb/gram)

Applicable emission factors for calculating emissions from POVs are provided in Section 4. Many of these emission factors are dependent on the vehicle model year (MY). Since the number of model years represented by POVs traveling on an Air Force installation is usually very high (i.e., typically > 20), attempting to calculate emissions for each different model year is usually not practical/feasible (except perhaps for very small/remote installations with little POV traffic). Therefore, calculating emissions from POVs is usually accomplished using average model years. This may be done using one of two methods. The first method is to estimate a single average model year for all POVs traveling on base and use this same model year for all calculations (i.e., use the same average model year for all vehicle categories). The second method is to estimate a separate average model year for each of the eight different vehicle categories (LDGV, LDGT1, LDDV, etc.). This second method is a little more accurate but should only be used if a good estimate is available for each of the different vehicle categories.

Once the average model year(s) are estimated, the total vehicle miles driven on the installation must be estimated for each different vehicle category. When computing the total vehicle miles driven, it's important to keep in mind that driving habits/patterns may differ significantly between weekdays and weekends.

Prior to conducting an AEI which includes POVs, it's highly recommended to determine if a recent traffic survey has been accomplished for the base. Typically, the Base Development and/or Community Planning sections of the Civil Engineering Squadron are the offices to contact for this information. The information collected during traffic surveys may be useful in helping derive some of the data needed to calculate POV emissions (e.g., estimated total vehicle miles driven on base, estimated percentage breakdown by vehicle type category, etc.). It's important to note that traffic surveys can vary quite significantly in scope. For example, one type of traffic survey may just involve the use of "counters" at the base gates to monitor traffic flow (i.e., number of vehicles) entering and/or exiting the base during a specific period of time. Another type of survey may involve the use of several people stationed at various locations on base (e.g., base gates, major intersections, major thruways, etc.) to record information on vehicle traffic. The time involved for these more comprehensive traffic surveys could range anywhere from less than one day to several days. In addition, the information collected during these more comprehensive surveys may vary. For example, some surveys may just include the number of vehicles, while other surveys might include the number of vehicles, the vehicle types, whether or not the vehicle has a government registration sticker, etc. It's also important to note that traffic flow on an Air Force installation may vary depending on the time of year. Therefore, if at all possible (i.e., if adequate time, manpower, funds, and other resources are available), multiple traffic surveys should be conducted (during different times of the year) and the results averaged in order to obtain the most representative data for the installation.

In many cases, a recent/current traffic survey for the base is not available, and conducting a new traffic survey is not possible (e.g., there are inadequate resources to conduct a new traffic survey). However, estimating emissions from POVs can usually be accomplished using data provided by the Security Forces Squadron (mainly from the Pass & Registration section) and/or the Military Personnel Flight (MPF) [note – at some installations the registration of vehicles is now accomplished at MPF]. Types of data which can usually be obtained from the Security Forces Squadron and/or MPF include the following: 1) the estimated average number of registered POVs at the installation during the applicable inventory year; 2) the estimated percentage of registered vehicles which fall under each of the eight vehicle categories; 3) the estimated average model year of the POVs traveling on base during the inventory year (note – if possible an average model year estimate for each vehicle category should be obtained, otherwise, a single estimated average model year for all vehicles should be obtained); 4) estimated distance (miles) the average POV travels on the installation during a typical weekday; 5) estimated distance (miles) the average POV travels on the installation during a typical weekend day; 6) estimated number of non-registered vehicles which travel on the installation during a typical weekday; and 7) estimated number of non-registered vehicles which travel on the installation during a typical weekend day. Figure 6-1 provides an example of a data collection form which may be used.

It's important to note that there is a more accurate/comprehensive approach to obtaining information on registered vehicles (i.e., information cited in items 1 through 3 of the above paragraph) which may be used at some installations. Instead of asking the Pass and Registration section (or MPF, whichever is applicable) for direct estimates on the number and types of registered vehicles on base, you can ask them for a listing (preferably in both an electronic and hardcopy format) of the registered vehicles in their database. At a minimum, this listing should contain the model type and model year for all registered vehicles [note - if available, the Vehicle Identification Number (VIN) for the registered vehicles should also be obtained as it contains useful/specific information about each vehicle]. Information from the listing can be used to determine the number of registered vehicles which fall under each of the eight vehicle type categories, as well as the average Model Year for each vehicle category.

When calculating emissions from POVs, AFIERA/RSEA recommends dividing the POVs into two groups, registered vehicles and non-registered vehicles. For each of the eight vehicle categories, the total vehicle miles traveled on the installation during the inventory year are calculated separately for registered vehicles and non-registered vehicles and the two values added together to obtain the total vehicle miles traveled. The following steps are recommended:

Step 1 – Ask the office which maintains vehicle registration data (Pass & Registration or MPF) if they can provide a listing (preferably in both an electronic and hard copy format) of the registered vehicles in their database **[note - if a listing <u>can not</u> be provided, discontinue with this step and go to Step 2]**. Perform a review of the information on the listing to determine if it's possible to segregate the registered vehicles by vehicle type category (e.g., LDGV, LDGT1, etc.) and by model year **[note – if the vehicles <u>can not</u> be segregated by <u>both</u> vehicle type category and model year, discontinue with this step and go to Step 2]**. If it is possible to segregate the vehicles, use the listing to identify the number of registered vehicles which fall under each of the eight vehicle type categories, and to calculate the average model year for each vehicle type category. **Next, skip Steps 2 through 4 and go to Step 5.**

Step 2 - Obtain (from Pass & Registration or MPF, whichever is applicable) an estimate of the average number of <u>registered</u> POVs at the installation during the inventory year.

Step 3 – Obtain (from Pass & Registration or MPF) the estimated percentage of registered vehicles which fall under each of the eight different vehicle categories [note – total of all eight percentages should equal 100]. If an estimated percentage breakdown by vehicle category cannot be provided, then the average on-road vehicle mix shown in Table 6-1 should be used. If possible, also obtain the estimated average model year for each of the vehicle categories (at the time of the inventory year). If this is not possible, then obtain a single estimated average model year applicable to all POVs driven on base during the inventory year.

Step 4 – Calculate the estimated number of registered vehicles which fall under each vehicle category using the following equation:

$$NV_{reg,XXXX} = NV_{reg,total} * (PV_{reg,XXXX} / 100)$$

Where,

$NV_{reg,XXXX}$ = Estimated number of registered vehicles which fall under vehicle category XXXX (vehicles)
$NV_{reg,total}$ = Estimated average number of total registered vehicles on the installation during the inventory year (vehicles)
$PV_{reg,XXXX}$ = Estimated percentage of registered vehicles which fall under vehicle category XXXX (%)
100 = Factor for converting percent into a fraction

Step 5 – Determine the estimated percentage of registered vehicles which actually travel on base during a typical weekday and during a typical weekend day, as well as the estimated distance (miles) the average POV travels on base during a typical weekday and during a typical weekend day. Please note that this information can be obtained using one or more of the following techniques: 1) by asking the Security Forces Squadron; 2) by conducting a survey of a representative number of base personnel who own registered vehicles; 3) by using data collected from a recent traffic survey.

Step 6 – Using the information from the steps above, calculate the estimated miles traveled on base by registered vehicles in each vehicle category by using the following equation:

$$VMT_{reg,XXXX} = [NV_{reg,XXXX} * (PV_{reg,weekday} / 100) * DDT_{weekday} * 251] + [NV_{reg,XXXX} * (PV_{reg,weekend} / 100) * DDT_{weekend} * 114]$$

Where,

$VMT_{reg,XXXX}$ = Estimated vehicle miles traveled during the year by registered vehicles belonging to vehicle category XXXX (miles/yr)
$NV_{reg,XXXX}$ = Estimated number of registered vehicles which fall under vehicle category XXXX (vehicles)
$PV_{reg,weekday}$ = Estimated percentage of registered vehicles which actually travel on base during a typical weekday (%)
$DDT_{weekday}$ = Estimated average daily distance traveled on base by a typical POV on a typical weekday (miles/day/vehicle)
251 = Number of weekdays in a typical year, minus holidays (days/yr)
$PV_{reg,weekdend}$ = Estimated percentage of registered vehicles which actually travel on base during a typical weekend day (%)
$DDT_{weekend}$ = Estimated average daily distance traveled on base by a typical POV on a typical weekend day (miles/day/vehicle)
114 = Number of weekend days in a typical year, plus weekday holidays (days/yr)

Step 7 – Obtain (from the Security Forces Squadron and/or from data collected in a recent traffic survey) an estimate of the number of non-registered vehicles traveling on base during a typical weekday and during a typical weekend day.

Step 8 – Using the information from Step 7 and the same estimated average daily distance traveled (DDT) values used for registered vehicles, calculate the estimated daily vehicle miles traveled by all non-registered vehicles on both a typical weekday and a typical weekend day:

$$DVMT_{non\text{-}reg,weekday} = NV_{non\text{-}reg,weekday} * DDT_{weekday}$$

$$DVMT_{non\text{-}reg,weekend} = NV_{non\text{-}reg,weekdend} * DDT_{weekend}$$

Where,

$DVMT_{non\text{-}reg,weekday}$ = Estimated daily vehicle miles traveled by all non-registered vehicles on a typical weekday (miles/day)

$NV_{non\text{-}reg,weekday}$ = Estimated number of non-registered vehicles traveling on base during a typical weekday (vehicles)

$DDT_{weekday}$ = Estimated average daily distance traveled on base by a typical POV on a weekday (miles/day/vehicle)

$DVMT_{non\text{-}reg,weekend}$ = Estimated daily vehicle miles traveled by all non-registered vehicles on a typical weekend day (miles/day)

$NV_{non\text{-}reg,weekend}$ = Estimated number of non-registered vehicles traveling on base during a typical weekend day (vehicles)

$DDT_{weekend}$ = Estimated average daily distance traveled on base by a typical POV on a weekend day (miles/day/vehicle)

Step 9 – Calculate the estimated total vehicle miles traveled on base during the year by non-registered vehicles:

$$VMT_{non\text{-}reg,total} = (DVMT_{non\text{-}reg,weekday} * 251) + (DVMT_{non\text{-}reg,weekend} * 114)$$

Where,

$VMT_{non\text{-}reg,total}$ = Estimated total vehicle miles traveled on base during the year by all non-registered vehicles (miles/yr)

$DVMT_{non\text{-}reg,weekday}$ = Estimated daily vehicle miles traveled by all non-registered vehicles on a typical weekday (miles/day)

251 = Number of weekdays in a typical year, minus holidays (days/yr)

$DVMT_{non\text{-}reg,weekend}$ = Estimated daily vehicle miles traveled by all non-registered vehicles on a typical weekend day (miles/day)

114 = Number of weekend days in a typical year, plus weekday holidays (days/yr)

Step 10 – Using the average on-road vehicle mix shown in Table 6-1, calculate the estimated vehicle miles traveled by non-registered vehicles which fall under each of the eight different vehicle categories.

$$VMT_{non\text{-}reg,XXXX} = VMT_{non\text{-}reg,total} * (PV_{non\text{-}reg,XXXX} / 100)$$

Where,

$VMT_{non\text{-}reg,XXXX}$ = Estimated vehicle miles traveled during the year by non-registered vehicles belonging to vehicle category XXXX (miles/yr)

$VMT_{non\text{-}reg,total}$ = Estimated total vehicle miles traveled on base during the year by all non-registered vehicles (miles/yr)

$PV_{non\text{-}reg,XXXX}$ = Estimated percentage of non-registered vehicles which fall under vehicle category XXXX (%) [note – use the average values listed in Table 6-1]

100 = Factor for converting percent into a fraction

Table 6-1. Average On-Road Vehicle Mix

Vehicle Category	Average On-Road Vehicle Mix (%)[a]
LDGV	68.9
LDGT1	11.4
LDGT2	8.5
HDGV	1.5
LDDV	3.9
LDDT	1.9
HDDV	2.9
MC	1.0
Total	**100**

[a] Values are the average of the calendar year 2000 and 2010 values listed in Appendix I to AP-42, Volume II.

Step 11 – For each of the eight vehicle categories, calculate the total POV miles traveled on base during the year by combining the registered and non-registered vehicle miles:

$$VMT_{POV,XXXX} = VMT_{reg,XXXX} + VMT_{non\text{-}reg,XXXX}$$

Where,

$VMT_{POV,XXXX}$ = Estimated vehicle miles traveled on base during the year by all POVs belonging to vehicle category XXXX (miles/yr)

$VMT_{reg,XXXX}$ = Estimated vehicle miles traveled during the year by registered vehicles belonging to vehicle category XXXX (miles/yr)

$VMT_{non\text{-}reg,XXXX}$ = Estimated vehicle miles traveled during the year by non-registered vehicles belonging to vehicle category XXXX (miles/yr)

Step 12 – Contact the Weather Detachment to determine what altitude (feet above sea level) the installation is at. Based on this value, classify the installation as either a low altitude location (i.e., ≤ 4,000 ft above sea level) or a high altitude location (i.e., > 4,000 feet above sea level).

Step 13 – Based on the estimated average model year(s) and the installation's altitude classification, obtain the applicable emission factors from Section 4 [note – one complete set of emission factors (i.e., one emission factor for each pollutant) should be obtained for each of the eight vehicle categories]

Step 14 – Calculate the total POV emissions for each pollutant using the first equation of this section. i.e.,

$$E_{POV,pol} = [(VMT_{POV,LDGV} * EF_{LDGV}) + (VMT_{POV,LDGT1} * EF_{LDGT1}) + (VMT_{POV,LDGT2} * EF_{LDGT2}) + (VMT_{POV,HDGV} * EF_{HDGV}) + (VMT_{POV,LDDV} * EF_{LDDV}) + (VMT_{POV,LDDT} * EF_{LDDT}) + (VMT_{POV,HDDV} * EF_{HDDV}) + (VMT_{POV,MC} * EF_{MC})] * 0.002205$$

6.3 Information Resources: Most information required to calculate emissions from POVs can usually be obtained from the Security Forces Squadron. The Pass & Registration section of the base Security Forces Squadron usually maintains computer records (including model type and model year) on all POVs registered at the installation. As mentioned in Section 6.2 above, it's important to note that at some installations the registration of vehicles is now being accomplished at MPF. The office that handles vehicle registrations (Pass & Registration or MPF) is also in good position to survey base personnel on their vehicle usage and driving habits (i.e., percentage of time their POVs are driven on base during typical weekdays and weekend days, average miles traveled on base during a typical weekday and weekend day, etc.). Since the Security Forces Squadron is responsible for manning the base gates, they are also usually the best source of information on non-registered vehicles (i.e., can best estimate the number of non-registered vehicles traveling on base during a typical weekday and typical weekend day). Figure 6-1 provides a good example of a data collection form which may be provided to the Security Forces Squadron (and MPF, if applicable) to help obtain the required information. If all of the required POV information cannot be obtained from the Security Forces Squadron, it might be necessary to survey a representative number of base personnel to obtain the required information. As mentioned in Section 6.2 above, it's also highly recommended that you check with the Base Development and/or Community Planning sections of the Civil Engineering Squadron to determine if any recent traffic surveys have been accomplished for the base. Finally, the base Weather Detachment should be contacted to obtain the installation's altitude (feet above sea level). The altitude is needed to determine whether the installation is at a low altitude location (i.e., $\leq$ 4,000 ft above sea level) or a high altitude location (i.e., > 4,000 feet above sea level).

6.4 Example Calculations: A small Air Force installation (Base XYZ) has a requirement to inventory the calendar year 2000 emissions associated with privately owned vehicles traveling on base. The Pass & Registration section of the installation's Security Forces Squadron was contacted and given a form to be completed which is similar to the form shown in Figure 6-1. A summary of the information provided on the form is shown on the next page.

Installation Name: Base XYZ	**Inventory Year (CY):** 2000
Responsible Organization (Name & Office Symbol): Pass & Registration, 123 SFS/SFAP	
POC (Name & Phone #): SSgt John Jones, DSN 234-5678	

Question	Response
Can you provide a listing of all registered vehicles on base? (Y/N) If so, be sure to include all specific information (model, model year, etc.) about the vehicles.	N
What is the estimated average number of registered privately owned vehicles (POVs) at the installation during the inventory year?	1,600
What is the estimated percentage of registered vehicles which actually travel on the installation during a typical weekday (i.e., Monday - Friday)?	75%
What is the estimated percentage of registered vehicles which actually travel on the installation during a typical weekend day (i.e., Staturday or Sunday)?	50%
What is the estimated distance the average POV travels on base during a typical weekday?	6 miles/day
What is the estimated distance the average POV travels on base during a typical weekend day?	4 miles/day
What is the estimated number of non-registered POVs which travel on base during a typical weeday?	125
What is the estimated number of non-registered POVs which travel on base during a typical weekend day?	60
What is the estimated average model year of all POVs driven on base during the inventory year? [note - this is not required if the average model years are listed below for each vehicle category]	

Motor vehicles can be placed into one of eight vehicle categories. Using registration information, please provide an estimate as to the percent of registered vehicles which fall under each vehicle category. If possible, please also provide the estimated average model year for each vehicle category.

Vehicle Category (see definitions below)	Estimated Percent Of Registered Vehicles Which Fall Under The Vehicle Category	Average Model Year
LDGV	74	1996
LDGT1	17	1995
LDGT2	1.5	1995
HDGV	0.25	1993
LDDV	4	1995
LDDT	2	1994
HDDV	0.25	1993
MC	1	1996
Total	**100**	

Vehicle Category Definitions

LDGV = Light duty gasoline-fueled vehicles (i.e., gasoline passenger cars)

LDGT1 = Light duty gasoline-fueled trucks, type 1 (includes gasoline pickup trucks, sport utility vehicles, and vans with a GVW of 6,000 pounds or less)

LDGT2 = Light duty gasoline-fueled trucks, type 2 (includes gasoline pickup trucks, sport utility vehicles, and vans with a GVW from 6,001 to 8,500 pounds)

HDGV = Heavy duty gasoline-fueled vehicles (includes all gasoline vehicles with a GVW exceeding 8,500 pounds)

LDDV = Light duty diesel-powered vehicles (i.e., diesel passenger cars)

LDDT = Light duty diesel-powered trucks (includes diesel pickup trucks, sport utility vehicles, and vans with a GVW of 8,500 pounds or less)

HDDV = Heavy-duty diesel-powered vehicles (includes diesel trucks and buses with a GVW exceeding 8,500 pounds)

MC = Motorcycles

Using the information provided by the Security Forces Squadron, calculate the CY 2000 emissions of carbon monoxide (CO) from POVs.

Step 1 – The first step is to calculate the estimated number of registered vehicles which fall under each vehicle category:

$NV_{reg,XXXX}$ = $NV_{reg,total}$ * ($PV_{reg,XXXX}$ / 100)
$NV_{reg,LDGV}$ = 1,600 vehicles * (74% / 100) = 1,184 vehicles
$NV_{reg,LDGT1}$ = 1,600 vehicles * (17% / 100) = 272 vehicles
$NV_{reg,LDGT2}$ = 1,600 vehicles * (1.5% / 100) = 24 vehicles
$NV_{reg,HDGV}$ = 1,600 vehicles * (0.25% / 100) = 4 vehicles
$NV_{reg,LDDV}$ = 1,600 vehicles * (4% / 100) = 64 vehicles
$NV_{reg,LDDT}$ = 1,600 vehicles * (2% / 100) = 32 vehicles
$NV_{reg,HDDV}$ = 1,600 vehicles * (0.25% / 100) = 4 vehicles
$NV_{reg,MC}$ = 1,600 vehicles * (1% / 100) = 16 vehicles

Step 2 – The second step is to calculate the estimated annual miles traveled on base by registered vehicles in each vehicle category:

$VMT_{reg,XXXX}$ = [$NV_{reg,XXXX}$ * ($PV_{reg,weekday}$ / 100) * $DDT_{weekday}$ * 251] + [$NV_{reg,XXXX}$ * ($PV_{reg,weekend}$ / 100) * $DDT_{weekend}$ * 114]
$VMT_{reg,LDGV}$ = [1,184 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [1,184 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 1,607,280 miles/yr
$VMT_{reg,LDGT1}$ = [272 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [272 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 369,240 miles/yr
$VMT_{reg,LDGT2}$ = [24 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [24 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 32,580 miles/yr
$VMT_{reg,HDGV}$ = [4 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [4 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 5,430 miles/yr
$VMT_{reg,LDDV}$ = [64 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [64 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 86,880 miles/yr
$VMT_{reg,LDDT}$ = [32 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [32 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 43,440 miles/yr
$VMT_{reg,HDDV}$ = [4 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [4 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 5,430 miles/yr
$VMT_{reg,MC}$ = [16 vehicles * (75% / 100) * 6 miles/day * 251 days/yr] + [16 vehicles * (50% / 100) * 4 miles/day * 114 days/yr] = 21,720 miles/yr

Step 3 – The next step is to estimate the daily vehicle miles traveled by all non-registered vehicles on both a typical weekday and a typical weekend day:

$DVMT_{non\text{-}reg,weekday}$ = $NV_{non\text{-}reg,weekday}$ * $DDT_{weekday}$
$DVMT_{non\text{-}reg,weekday}$ = 125 vehicles * 6 miles/day/vehicle = 750 miles/day

$DVMT_{non\text{-}reg,weekend}$ = $NV_{non\text{-}reg,weekdend}$ * $DDT_{weekend}$

$DVMT_{non\text{-}reg,weekend}$ = 60 vehicles * 4 miles/day/vehicle = 240 miles/day

Step 4 – The fourth step is to calculate the estimated total vehicle miles traveled on base during the year by all non-registered vehicles:

$VMT_{non\text{-}reg,total}$ = ($DVMT_{non\text{-}reg,weekday}$ * 251) + ($DVMT_{non\text{-}reg,weekend}$ * 114)
$VMT_{non\text{-}reg,total}$ = (750 miles/day * 251 days/yr) + (240 miles/day * 114 days/yr)
= 215,610 miles/yr

Step 5 – The next step is to use the values in Table 6-1 to calculate the estimated annual vehicle miles traveled by non-registered vehicles in each of the eight different vehicle categories.

$VMT_{non\text{-}reg,XXXX}$ = $VMT_{non\text{-}reg,total}$ * ($PV_{non\text{-}reg,XXXX}$ / 100)
$VMT_{non\text{-}reg,LDGV}$ = 215,610 miles/yr * (68.9% / 100) = 148,555 miles/yr
$VMT_{non\text{-}reg,LDGT1}$ = 215,610 miles/yr * (11.4% / 100) = 24,580 miles/yr
$VMT_{non\text{-}reg,LDGT2}$ = 215,610 miles/yr * (8.5% / 100) = 18,327 miles/yr
$VMT_{non\text{-}reg,HDGV}$ = 215,610 miles/yr * (1.5% / 100) = 3,234 miles/yr
$VMT_{non\text{-}reg,LDDV}$ = 215,610 miles/yr * (3.9% / 100) = 8,409 miles/yr
$VMT_{non\text{-}reg,LDDT}$ = 215,610 miles/yr * (1.9% / 100) = 4,097 miles/yr
$VMT_{non\text{-}reg,HDDV}$ = 215,610 miles/yr * (2.9% / 100) = 6,253 miles/yr
$VMT_{non\text{-}reg,MC}$ = 215,610 miles/yr * (1.0% / 100) = 2,156 miles/yr

Step 6 – The sixth step is to calculate the annual total POV miles traveled on base during the year for each of the eight different vehicle categories by adding together the annual registered POV miles and the annual non-registered POV miles:

$VMT_{POV,XXXX}$ = $VMT_{reg,XXXX}$ + $VMT_{non\text{-}reg,XXXX}$
$VMT_{POV,LDGV}$ = 1,607,280 miles/yr + 148,555 miles/yr = 1,755,835 miles/yr
$VMT_{POV,LDGT1}$ = 369,240 miles/yr + 24,580 miles/yr = 393,820 miles/yr
$VMT_{POV,LDGT2}$ = 32,580 miles/yr + 18,327 miles/yr = 50,907 miles/yr
$VMT_{POV,HDGV}$ = 5,430 miles/yr + 3,234 miles/yr = 8,664 miles/yr
$VMT_{POV,LDDV}$ = 86,880 miles/yr + 8,409 miles/yr = 95,289 miles/yr
$VMT_{POV,LDDT}$ = 43,440 miles/yr + 4,097 miles/yr = 47,537 miles/yr
$VMT_{POV,HDDV}$ = 5,430 miles/yr + 6,253 miles/yr = 11,683 miles/yr
$VMT_{POV,MC}$ = 21,720 miles/yr + 2,156 miles/yr = 23,876 miles/yr

Step 7 – The next step is to contact the Weather Detachment to obtain the installation's altitude. According to the Weather Detachment, the installation is approximately 2,200 feet above sea level. Since the altitude is less than 4,000 feet above sea level, the installation is considered to be in a low altitude location.

Step 8 – The eighth step is to identify the applicable emissions factors based on vehicle category, average model year, the fact the installation is at a low altitude location, and the fact that the inventory is for calendar year 2000. A review of the emission factors listed in Section 4 reveals the following applicable emission factors:

Vehicle Category	Average Model Year	CO Emission Factor* (grams/mile)
LDGV	1996	14.6
LDGT1	1995	21.8
LDGT2	1995	22.5
HDGV	1993	19.2
LDDV	1995	1.5
LDDT	1994	1.8
HDDV	1993	11.5
MC	1996	22.1

*Emission factors are based on values listed for January 1, 2001.

Step 9 – The ninth and final step is to calculate the CO emissions using the applicable emission factors and vehicle miles traveled:

$$E_{POV,pol} = [(VMT_{POV,LDGV} * EF_{LDGV}) + (VMT_{POV,LDGT1} * EF_{LDGT1}) + (VMT_{POV,LDGT2} * EF_{LDGT2}) + (VMT_{POV,HDGV} * EF_{HDGV}) + (VMT_{POV,LDDV} * EF_{LDDV}) + (VMT_{POV,LDDT} * EF_{LDDT}) + (VMT_{POV,HDDV} * EF_{HDDV}) + (VMT_{POV,MC} * EF_{MC})] * 0.002205$$

E_{CO} = [(1,755,835 miles/yr * 14.6 grams/mile) + (393,820 miles/yr * 21.8 grams/mile) + (50,907 miles/yr * 22.5 grams/mile) + (8,664 miles/yr * 19.2 grams/mile) + (95,289 miles/yr * 1.5 grams/mile) + (47,537 miles/yr * 1.8 grams/mile) + (11,683 miles/yr * 11.5 grams/mile) + (23,876 miles/yr * 22.1 grams/mile)] * 0.002205 lb/gram

= **80,312 lb/yr (40.16 tons/yr)**

Figure 6-1. Example Data Collection Form for Privately Owned Vehicles (POVs)

Installation Name:	**Inventory Year (CY):**
Responsible Organization (Name & Office Symbol):	
POC (Name & Phone #):	

Question	Response
Can you provide a listing of all registered vehicles on base? (Y/N) If so, be sure to include all specific information (model, model year, etc.) about the vehicles.	
What is the estimated average number of registered privately owned vehicles (POVs) at the installation during the inventory year?	
What is the estimated percentage of registered vehicles which actually travel on the installation during a typical weekday (i.e., Monday - Friday)?	
What is the estimated percentage of registered vehicles which actually travel on the installation during a typical weekend day (i.e., Staturday or Sunday)?	
What is the estimated distance the average POV travels on base during a typical weekday?	__ miles/day
What is the estimated distance the average POV travels on base during a typical weekend day?	__ miles/day
What is the estimated number of non-registered POVs which travel on base during a typical weeday?	
What is the estimated number of non-registered POVs which travel on base during a typical weekend day?	
What is the estimated average model year of all POVs driven on base during the inventory year? [note - this is not required if the average model years are listed below for each vehicle category]	

Motor vehicles can be placed into one of eight vehicle categories. Using registration information, please provide an estimate as to the percent of registered vehicles which fall under each vehicle category. If possible, please also provide the estimated average model year for each vehicle category.

Vehicle Category (see definitions below)	Estimated Percent Of Registered Vehicles Which Fall Under The Vehicle Category	Average Model Year
LDGV		
LDGT1		
LDGT2		
HDGV		
LDDV		
LDDT		
HDDV		
MC		
Total	**100**	

Vehicle Category Definitions

LDGV = Light duty gasoline-fueled vehicles (i.e., gasoline passenger cars)

LDGT1 = Light duty gasoline-fueled trucks, type 1 (includes gasoline pickup trucks, sport utility vehicles, and vans with a GVW of 6,000 pounds or less)

LDGT2 = Light duty gasoline-fueled trucks, type 2 (includes gasoline pickup trucks, sport utility vehicles, and vans with a GVW from 6,001 to 8,500 pounds)

HDGV = Heavy duty gasoline-fueled vehicles (includes all gasoline vehicles with a GVW exceeding 8,500 pounds)

LDDV = Light duty diesel-powered vehicles (i.e., diesel passenger cars)

LDDT = Light duty diesel-powered trucks (includes diesel pickup trucks, sport utility vehicles, and vans with a GVW of 8,500 pounds or less)

HDDV = Heavy-duty diesel-powered vehicles (includes diesel trucks and buses with a GVW exceeding 8,500 pounds)

MC = Motorcycles

SECTION 7

NONROAD VEHICLES/EQUIPMENT

7.1 Background: Several types of nonroad vehicles/equipment are typically found on Air Force installations. Examples include aerospace ground support equipment (AGE), construction equipment (e.g., backhoes, bulldozers, asphalt pavers, etc.), industrial equipment (e.g., forklifts, aerial lifts, sweepers, etc.), lawn and garden equipment (lawn mowers, trimmers, leaf blowers, snow blowers, etc.), agricultural equipment (sprayers, agricultural tractors, agricultural mowers, etc.), commercial equipment (e.g., portable generators, pumps, air compressors, etc.), recreational vehicles (e.g., off-road motorcycles, all terrain vehicles, including utility vehicles, snowmobiles, golf carts, etc.) and logging equipment (e.g., shredders). It's important to note that although AGE falls under the category of nonroad vehicles/equipment, non-vehicular AGE (i.e., AGE which is not self-propelled) is already specifically addressed in Section 2.

Most nonroad vehicles/equipment are fueled with either gasoline or diesel. Due to increasingly stringent air quality regulations and pollution prevention initiatives, some Air Force installations may also have nonroad vehicles/equipment which burn "clean fuels," such as liquid petroleum gas (LPG) or compressed natural gas (CNG). Also, because of the Air Force wide conversion to JP-8 fuel, some nonroad vehicles/equipment in the Air Force may be fueled with JP-8. Due to the lack of emission factors for nonroad vehicles/equipment using JP-8, and the fact that JP-8 is very similar to diesel, emissions from JP-8 fueled vehicles/equipment should be calculated using the emission factors for similar vehicles/equipment using diesel fuel (except for SO_X emissions which should be calculated based on the sulfur content of the JP-8 fuel, as specified in subsection 7.2 below).

There are two primary types of internal combustion engines which may be used in nonroad vehicles/equipment: reciprocating and gas turbine. With reciprocating engines, a combustible mixture is first compressed in a small volume between the head of a piston and its surrounding cylinder. The mixture is then ignited, and the resulting high-pressure products of combustion push the piston through the cylinder. This movement is converted from linear to rotary motion by a crankshaft. The piston returns, pushing out exhaust gases, and the cycle is repeated.

There are two methods used for reciprocating internal combustion engines: compression ignition (CI) and spark ignition (SI). Diesel and JP-8 fueled engines are compression ignited while gasoline, LPG, and CNG fueled engines are spark ignited. In CI engines, combustion air is first compression heated in the cylinder, and diesel fuel is then injected into the hot air. Ignition is spontaneous because the air temperature is above the autoignition temperature of the fuel. SI engines initiate combustion by the spark of an electrical discharge. Usually the fuel is mixed with the air in a carburetor (for gasoline) or at the intake valve (for natural gas), but occasionally the fuel is injected into the compressed air in the cylinder.

SI reciprocating engines are also separated into different design classes: 2-stroke lean burn, 2-stroke ultra lean (clean) burn, 4-stroke lean burn, 4-stroke clean burn, and 4-stroke rich burn. Each of these have design differences that affect both uncontrolled emissions as well as the potential for emissions control. Two-stroke engines complete the power cycle in a single

crankshaft revolution as compared to the two crankshaft revolutions required for 4-stroke engines.

In a 2-stroke engine, the air/fuel charge is injected with the piston near the bottom of the power stroke. The intake ports are then covered or closed, and the piston moves to the top of the cylinder, thereby compressing the charge. Following ignition and combustion, the power stroke starts with the downward movement of the piston. Exhaust ports or valves are then uncovered to exhaust the combustion products, and a new air/fuel charge is injected.

Four-stroke engines use a separate engine revolution for the intake/compression cycle and the power/exhaust cycle. These engines may be either naturally aspirated, using the suction from the piston to entrain the air charge, or turbocharged, using an exhaust-driven turbine to pressurize the charge. Turbocharged units produce a higher power output for a given engine displacement, whereas naturally aspirated units have lower initial cost and maintenance. Rich burn engines operate near the stoichiometric air/fuel ratio with exhaust excess oxygen levels less than 4 percent. Lean burn engines may operate up to the lean flame extinction limit, with exhaust oxygen levels of 12 percent or greater.

Gas turbines are essentially composed of three major components: compressor, combustor, and power turbine. Ambient air is drawn in and compressed up to 30 times ambient pressure and directed to the combustor section where fuel is introduced, ignited, and burned. The hot expanding exhaust gases are then passed into the power turbine to produce usable shaft energy [note - more than 50 percent of the shaft energy produced is needed to drive the internal compressor. The balance is available to drive an external load].

With the exception of a few types of AGE which have gas turbine engines, virtually all nonroad vehicles/equipment used at Air Force installations are powered with reciprocating engines. For this reason, gas turbine vehicles/equipment are not addressed in this section. If other types of gas turbine vehicles/equipment, such as Army tanks, are used at your installation, AFIERA/RSEA can be contacted for assistance in identifying possible emission factors to use.

7.2 Emission Calculations: There are three primary/optional methods which may be used to calculate emissions from most nonroad vehicles/equipment. Method selection should be based on available information. A fourth method is generally used to calculate emissions specifically from off-road motorcycles and all terrain vehicles (ATVs), due to the unique units of the emission factors associated with these types of vehicles. A fifth method is used specifically for calculating hazardous air pollutants (HAP) emissions. A summary of all five methods is provided below.

a. Method 1 (optional to Methods 2 and 3)

The first and most common method for calculating emissions from nonroad vehicles/equipment involves using the engine's rated power output (maximum horsepower), a loading factor, the engine's annual operating time, and emission factors which are based on mass of pollutant emitted per power output. The following equation is used for Method 1:

$$E_{pol} = [(PO * (LF / 100) * OT)] * EF * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
PO = Rated power output of the vehicle/equipment engine (hp)
LF = Loading Factor (% of Maximum Power)
100 = Factor for converting percent to a fraction
OT = Operating time (hr/yr)
EF = Emission Factor (g/hp-hr)
0.002205 = Conversion Factor (lb/g)

The loading factor mentioned above is defined as the percent of maximum power at which the engine is operated. Typical loading factors for various types of gasoline and diesel fueled nonroad vehicles/equipment are listed in Table 7-1 below. However, actual site specific loading factors should be used whenever possible.

Table 7-1. Typical Load Factors for Various Nonroad Vehicles/Equipment[a]

Vehicle/Equipment Type	SCC[b]	Load Factor (% of Max. Power)	
		Diesel Fueled	Gasoline Fueled
Generator Sets	A22xx006005	74	68
Air Compressors	A22xx006015	48	56
Pumps	A22xx006010	74	69
Refrigeration/AC	A22xx003060	28	46
Tactical Military Equipment	-----	62	68
Terminal Tractors	A22xx003070	82	78
Welders	A22xx006025	45	51
Forklifts	A22xx003020	30	30
Other Material Handling	A22xx003050	59	53
Scrubbers/Sweepers	A22xx003030	68	71
Surfacing Equipment	A22xx002024	45	49
Forest Equipment	A22xx007015	71	70
Chippers/Grinders	A22xx004066	73	78
Cranes	A22xx002045	43	47
Excavators	A22xx002036	57	53
Scrapers	A22xx002018	72	70
Graders	A22xx002048	61	64
Crawler Dozers/Tractor	A22xx002069	64	80
Rubber Tire Dozer	A22xx002063	59	75
Rubber Tire Loader	A22xx002060	68	71
Crush/Processing Equipment	A22xx002054	78	85
Paving Equipment	A22xx002021	53	59

Table 7-1. Typical Load Factors for Various Nonroad Vehicles/Equipment[a] (Cont'd)

Vehicle/Equipment Type	SCC[b]	Load Factor (% of Max. Power)	
		Diesel Fueled	Gasoline Fueled
Other Construction	A22xx002081	62	48
Bore/Drill Rigs	A22xx002033	75	79
Skid Steer Loader	A22xx002072	55	58
Rollers	A22xx002015	56	62
Off-Highway Truck	A22xx002051	57	80
Pavers	A22xx002003	62	66
Trenchers	A22xx002030	75	66
Tractor\Loader\Backhoe	A22xx002066	55	48
Agricultural Tractor	A22xx005015	70	62
Other Agricultural Equipment	A22xx005055	51	55
Trimmer/Edger/Cutter	A22xx004025 A22xx004026	43	68
Agricultural Mowers	A22xx005030	43	48
Snowblower	A22xx004035 A22xx004036	65	78
Cement/Material Mixers	A22xx002042	56	59
Pressure Washer	A22xx006030	30	85
Tillers	A22xx005040	78	71
Dumpers/Tenders	A22xx002078	38	41
Plate Compactors	A22xx002009	43	55
Specialty Vehicle/Carts	A22xx001060	65	58
Lawn and Garden Tractor	A22xx004055 A22xx004056	57	62
Aerial Lifts	A22xx003010	46	46
Lawn Mowers	A22xx004010 A22xx004011	55	70
Leaf Blower/Vacuum	A22xx004030 A22xx004031	40	75
Commercial Turf Equipment	A22xx004071	55	60
Off-Highway Tractors	A22xx003070	65	70
Sprayers	A22xx005035	58	65
Chainsaws	A2260004020 A2260004021 A2260007005	60	92
Snowmobiles	A22xx001020	40	81
Light Plants\Signal Boards	A22xx002027	78	72
Other General Industrial	A22xx003040	51	54
Wood Splitter	A22xx004060 A22xx004061	55	69

Table 7-1. Typical Load Factors for Various Nonroad Vehicles/Equipment[a] (Cont'd)

Vehicle/Equipment Type	SCC[b]	Load Factor (% of Max. Power)	
		Diesel Fueled	Gasoline Fueled
Other Lawn Garden	A22xx004075 A22xx004076	65	58
Concrete/Industrial Saws	A22xx002039	73	78
Aircraft Support	A22xx008005	51	56
Rear Engine Riding Mower	A22xx004040	64	67
Rough Terrain Forklifts	A22xx002057	60	63
Hydro Power Unit	A22xx005050	48	56
Front Mowers	A22xx004055 A22xx004056	56	65
Gas Compressors	A22xx006020	60	60
All-Terrain Vehicles\Off-road Motorcycles	A22xx001030	-----	72
Mini-Bikes	A22xx001040	-----	62
Golf Carts	A22xx001050	49	46
Tampers/Rammers	A22xx002006	43	55
Shredders	A22xx004050 A22xx004051 A22xx007010	40	80
2-Wheel Tractors	A22xx005010	62	62

[a] All data was obtained from Table 4 of Reference 4.
[b] An "x" in the SCC refers to any applicable number.

b. Method 2 (optional to Methods 1 and 3)

The second method for calculating emissions from nonroad vehicles/equipment is typically used in lieu of Method 1 when the operating time is unknown, but the fuel consumption is known. Method 2 involves the use of the annual fuel consumption, fuel density, typical brake-specific fuel consumption for the vehicle/equipment, and emission factors which are based on mass of pollutant emitted per power output. The following equation is used:

$$E_{pol} = [(FC * FD) / BSFC] * EF * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
FC = Fuel consumption (gal/yr)
FD = Fuel density (lb/gal) [note – default values include: 6.09 for gasoline, 7.11 for diesel, and 6.8 for JP-8]
BSFC = Typical brake-specific fuel consumption for the vehicle/equipment (lb/hp-hr) [note – use the most applicable value listed in the emission factor tables]

EF = Emission Factor (g/hp-hr)
0.002205 = Conversion Factor (lb/g)

c. Method 3 (optional to Methods 1 and 2)

The third method for calculating emissions from nonroad vehicles/equipment is typically used when the vehicle/equipment fuel consumption is known, and emission factors are available which are based on mass of pollutant emitted per volume of fuel consumed. The following equation is used:

$$E_{pol} = FC * EF * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
FC = Fuel consumption (gal/yr)
EF = Emission Factor (g/gal)
0.002205 = Conversion Factor (lb/g)

d. Method 4 (for motorcycles, all terrain vehicles, and utility vehicles)

As mentioned above, the fourth method is generally used to calculate emissions from off-road motorcycles and all terrain vehicles (ATVs) due to the unique units of the emission factors associated with these types of vehicles [note – small utility vehicles, like the Kawasaki Mule™, are commonly found at Air Force installations. For inventory calculation purposes, these utility vehicles should be considered ATVs]. This fourth method is similar to Method 1 except it does not include the rated power output of the vehicle/equipment engine.

$$E_{pol} = [(LF / 100) * OT)] * EF * 0.002205$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
LF = Loading Factor (% of Maximum Power)
100 = Factor for converting percent to a fraction
OT = Operating time (hr/yr)
EF = Emission Factor (g/hr)
0.002205 = Conversion Factor (lb/g)

e. Method 5 (for HAP emissions)

As mentioned above, this fifth method is specific to the calculation of HAP emissions. In general, HAP emissions are calculated based on the speciation of the VOC emissions. The following equation is used:

$$E_{HAP} = E_{VOC} * (WP_{HAP} / 100)$$

Where,

E_{HAP} = Emissions of a particular HAP (lb/yr)
E_{VOC} = VOC Emissions (lb/yr)
WP_{HAP} = Weight Percent of the HAP in the VOC emissions (%)
100 = Factor for converting weight percent to a fraction

Pollutant emission factors for specific types/sizes of nonroad vehicles/equipment are listed in Tables 7-2 through 7-7, while more general emission factors for internal combustion engines are found in Tables 7-8 through 7-9. HAP speciation values are provided in Table 7-10.

In addition to the emission factors and speciation values provided in Tables 7-2 through 7-10, it's important to note that most manufacturers have emissions data specific to their vehicles/equipment, and that many of these manufacturers will provide their data to the public upon request.

7.3 Information Resources: The primary source of information for most nonroad vehicles/equipment is the Transportation Squadron. The Transportation Vehicle Operations Flight and/or the Transportation Vehicle Maintenance Flight typically maintain records on most Air Force owned nonroad vehicles/equipment, such as identity of the shops/organizations operating the vehicles/equipment, horsepower rating of the vehicles/equipment, and hours of operation. In some cases, it may be necessary to contact the actual organizations/shops using the vehicles/equipment to obtain information that Transportation does not have. For example, for construction equipment and lawn/garden equipment, it will probably be necessary to contact the Civil Engineering (CE) Operations Flight, the CE Engineering Flight, and the CE Housing Flight. It's important to note that many of the construction and lawn care activities at Air Force installations are performed via contractors, and therefore, it might be necessary to contact the contractors directly to obtain the necessary information on their equipment. The Contracts section of the CE Engineering Flight should be able to provide information on what contracts were used to perform construction and lawn care activities on base during the year.

Some nonroad vehicles/equipment operated on Air Force installations are owned by personnel who live on base. Most of this is in the form of lawn and garden equipment (e.g., residential lawn mowers, trimmers/edgers, leaf blowers, snow blowers, tillers, etc.) owned/used by people in base housing. Since this equipment is privately owned, obtaining information is usually more difficult than for Air Force owned equipment. One approach is to work with the CE Housing Flight to identify the types of nonroad equipment used in base housing, estimate the number of each different equipment type, estimate the average horsepower of each equipment type, and estimate the average operating time (hours per year) for each equipment type. If adequate resources/time are available, a more comprehensive approach would be to survey a representative number of housing units to determine the type/size of equipment used and the estimated usage.

For nonroad vehicles/equipment in which emissions are calculated using emission factors based on fuel usage (i.e., using "g/gal" emission factors), Fuels Supply may be a source of information regarding fuel consumption.

An example of a data collection form which can be used to collect data on nonroad vehicles/equipment is provided in Figure 7-1.

7.4 Example Calculations: A small Air Force base has a requirement to conduct a calendar year 2000 mobile source emissions inventory. Calculate the CO emissions associated with Air Force owned nonroad vehicles/equipment operated by Shop X.

Step 1 – The first step is to visit the Transportation Squadron to collect information they have on the nonroad vehicles/equipment used by Shop X. A form similar to the one shown in Figure 7-1 should be filled out.

Step 2 – The next step is to review the data collected at the Transportation Squadron to determine what, if any, information needed to conduct the calculations is missing.

Step 3 – If any information is missing, then the next step is to visit Shop X to collect the missing data. A summary of the information collected (at both the Transportation Squadron and Shop X) is as follows:

Equipment Type	Equipment ID	Fuel Type	Model Year (Diesel only)	Horsepower Rating (hp)	Load Factor (%)	Estimated Operating Time (hr/yr)
Forklift (4-stroke)	FL-1	Diesel	1994	80	Unknown	70
Backhoe (4-stroke)	BH-1	Diesel	1992	75		80
Forklift (4-stroke)	FL-2	Gasoline	N/A	65		75
All Terrain Vehicle (ATV) (4-stroke)	ATV-1	Gasoline	N/A	N/A		110
Snowblower (4-stroke)	SB-1	Gasoline	N/A	8		25
Lawnmower (4-stroke)	LM-1	Gasoline	N/A	6.5		40
Trimmer/Edger (2-stroke)	TE-1	Gasoline	N/A	4		30
Leaf Blower (2-stroke)	LB-1	Gasoline	N/A	2		20

Step 4 – Since the load factors are unknown, applicable values listed in Table 7-1 should be used. These load factors include the following:

Equipment Type	Fuel Type	Typical Load Factor (%) [from Table 7-1]
Forklift	Diesel	30
Backhoe	Diesel	48
Forklift	Gasoline	30
All Terrain Vehicle (ATV)	Gasoline	72
Snowblower	Gasoline	78
Lawnmower	Gasoline	70
Trimmer/Edger	Gasoline	68
Leaf Blower	Gasoline	75

Step 5 – Once all the required information is collected, calculations can be performed as follows:

For all Shop X nonroad vehicles/equipment except the All Terrain Vehicle (ATV)

E_{pol} = [(PO * (LF / 100) * OT)] * EF * 0.002205

FL-1 E_{CO} = [(80 hp * (30% / 100) * 70 hr/yr)] * 8.1 g/hp-hr * 0.002205 lb/g = 30 lb/yr

BH-1 E_{CO} = [(75 hp * (48% / 100) * 80 hr/yr)] * 8.1 g/hp-hr * 0.002205 lb/g = 51 lb/yr

FL-2 E_{CO} = [(65 hp * (30% / 100) * 75 hr/yr)] * 199 g/hp-hr * 0.002205 lb/g = 642 lb/yr

SB-1 E_{CO} = [(8 hp * (78% / 100) * 25 hr/yr)] * 429 g/hp-hr * 0.002205 lb/g = 148 lb/yr

LM-1 E_{CO} = [(6.5 hp * (37% / 100) * 40 hr/yr)] * 429 g/hp-hr * 0.002205 lb/g = 91 lb/yr

TE-1 E_{CO} = [(4 hp * (68% / 100) * 30 hr/yr)] * 719 g/hp-hr * 0.002205 lb/g = 129 lb/yr

LB-1 E_{CO} = [(2 hp * (75% / 100) * 20 hr/yr)] * 719 g/hp-hr * 0.002205 lb/g = 48 lb/yr

For the All Terrain Vehicle (ATV)

E_{pol} = [(LF / 100) * OT)] * EF * 0.002205

ATV-1 E_{CO} = [(72% / 100) * 110 hr/yr)] * 975 g/hr * 0.002205 lb/g = 170 lb/yr

Total CO Emissions

Total E_{CO} = 30 + 51 + 642 + 148 + 91 +129 + 48 +170 = **1,309 lb/yr**

Table 7-2. Criteria Pollutant Emission Factors for 2-Stroke Gasoline Nonroad Vehicles/Equipment[a]

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Recreational Equipment									
Off-Road Motorcycles	A2260001010	3, 6, 16, 25, 50, 100	1.30	600	800	1.50	8.20	0.95	g/hr
Snowmobiles	A2260001020	25, 50, 100	1.30	109	169	1.70	4.80	0.15	g/hp-hr
All Terrain Vehicles (ATVs)	A2260001030	3, 6, 16, 25, 50, 100	1.30	600	800	1.50	8.20	0.95	g/hr
Minibikes	A2260001040	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Minibikes	A2260001040	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Golf Carts	A2260001050	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Golf Carts	A2260001050	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Specialty Vehicles Carts	A2260001060	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Specialty Vehicles Carts	A2260001060	16	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Construction Equipment									
Asphalt Pavers	A2260002003	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Asphalt Pavers	A2260002003	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Tampers/Rammers	A2260002006	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Tampers/Rammers	A2260002006	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Plate Compactors	A2260002009	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Plate Compactors	A2260002009	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Concrete Pavers	A2260002012	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Concrete Pavers	A2260002012	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Rollers	A2260002015	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Rollers	A2260002015	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Scrapers	A2260002018	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Scrapers	A2260002018	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Paving Equipment	A2260002021	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Paving Equipment	A2260002021	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Surfacing Equipment	A2260002024	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Surfacing Equipment	A2260002024	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Signal Boards	A2260002027	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Signal Boards	A2260002027	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Trenchers	A2260002030	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Trenchers	A2260002030	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Bore/Drill Rigs	A2260002033	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Bore/Drill Rigs	A2260002033	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Excavators	A2260002036	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Excavators	A2260002036	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Concrete/Industrial Saws	A2260002039	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Concrete/Industrial Saws	A2260002039	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Cement and Mortar Mixers	A2260002042	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Cement and Mortar Mixers	A2260002042	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Cranes	A2260002045	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Cranes	A2260002045	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Graders	A2260002048	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Graders	A2260002048	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Off-Highway Trucks	A2260002051	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Off-Highway Trucks	A2260002051	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Crushing/Proc. Equipment	A2260002054	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Crushing/Proc. Equipment	A2260002054	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Rough Terrain Forklifts	A2260002057	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Rough Terrain Forklifts	A2260002057	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr

Table 7-2. Criteria Pollutant Emission Factors for 2-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Rubber Tired Loaders	A2260002060	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Rubber Tired Loaders	A2260002060	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Rubber Tired Dozers	A2260002063	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Rubber Tired Dozers	A2260002063	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Tractors/Loaders/Backhoes	A2260002066	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Tractors/Loaders/Backhoes	A2260002066	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Crawler Tractors	A2260002069	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Crawler Tractors	A2260002069	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Skid Steer Loaders	A2260002072	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Skid Steer Loaders	A2260002072	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Off-Highway Tractors	A2260002075	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Off-Highway Tractors	A2260002075	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Dumpers/Tenders	A2260002078	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Dumpers/Tenders	A2260002078	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Other Construction Equipment	A2260002081	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Other Construction Equipment	A2260002081	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Industrial Equipment									
Aerial Lifts	A2260003010	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Aerial Lifts	A2260003010	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Forklifts	A2260003020	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Forklifts	A2260003020	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Sweepers/Scrubbers	A2260003030	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Sweepers/Scrubbers	A2260003030	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Other General Industrial Equipment	A2260003040	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Other General Industrial Equipment	A2260003040	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Other Material Handling Equipment	A2260003050	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Other Material Handling Equipment	A2260003050	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Industrial Tractors	A2260003060	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Industrial Tractors	A2260003060	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Lawn and Garden Equipment									
Lawn Mowers	A2260004010, A2260004011	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Lawn Mowers	A2260004010, A2260004011	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Tillers < 6 hp	A2260004015, A2260004016	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Chainsaws < 6 hp	A2260004020, A2260004021	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Chainsaws < 6 hp	A2260004020, A2260004021	6	1.30	214	696	1.3	3.6	0.25	g/hp-hr
Trimmers/Edgers/Brush Cutters	A2260004025, A2260004026	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Trimmers/Edgers/Brush Cutters	A2260004025, A2260004026	6	1.30	214	696	1.3	3.6	0.25	g/hp-hr
Trimmers/Edgers/Brush Cutters	A2260004025, A2260004026	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Leaf Blowers/Vacuums	A2260004030, A2260004031	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Leaf Blowers/Vacuums	A2260004030, A2260004031	6	1.30	214	696	1.3	3.6	0.25	g/hp-hr

Table 7-2. Criteria Pollutant Emission Factors for 2-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Leaf Blowers/Vacuums	A2260004030, A2260004031	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Snowblowers	A2260004035, A2260004036	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Snowblowers	A2260004035, A2260004036	6	1.30	214	696	1.3	3.6	0.25	g/hp-hr
Snowblowers	A2260004035, A2260004036	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Rear Engine Riding Mowers	A2260004040	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Rear Engine Riding Mowers	A2260004040	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Front Engine Riding Mowers	A2260004045	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Front Engine Riding Mowers	A2260004045	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Shredders < 6 hp	A2260004050, A2260004051	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Lawn & Garden Tractors	A2260004055	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Lawn & Garden Tractors	A2260004055	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Wood Splitters	A2260004060	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Wood Splitters	A2260004060	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Chippers/Stump Grinders	A2260004065	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Chippers/Stump Grinders	A2260004065	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Commercial Turf Equipment	A2260004070, A2260004071	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Commercial Turf Equipment	A2260004070, A2260004071	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Other Lawn & Garden Equipment	A2260004075, A2260004076	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Other Lawn & Garden Equipment	A2260004075, A2260004076	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Agricultural Equipment									
2-Wheel Tractors	A2260005010	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
2-Wheel Tractors	A2260005010	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Agricultural Tractors	A2260005015	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Agricultural Tractors	A2260005015	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Agricultural Mowers	A2260005030	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Agricultural Mowers	A2260005030	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Sprayers	A2260005035	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Sprayers	A2260005035	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Tillers > 6 hp	A2260005040	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Tillers > 6 hp	A2260005040	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Hydro Power Units	A2260005050	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Hydro Power Units	A2260005050	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Other Agricultural Equipment	A2260005055	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Other Agricultural Equipment	A2260005055	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Commercial Equipment									
Generator Sets	A2260006005	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Generator Sets	A2260006005	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Pumps	A2260006010	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Pumps	A2260006010	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Air Compressors	A2260006015	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Air Compressors	A2260006015	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Gas Compressors	A2260006020	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Gas Compressors	A2260006020	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Welders	A2260006025	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Welders	A2260006025	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr

Table 7-2. Criteria Pollutant Emission Factors for 2-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Pressure Washers	A2260006030	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Pressure Washers	A2260006030	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Logging Equipment									
Chainsaws > 6 hp	A2260007005	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Chainsaws > 6 hp	A2260007005	16, 25	1.30	152	486	0.29	7.7	0.30	g/hp-hr
Shredders > 6 hp	A2260007010	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Shredders > 6 hp	A2260007010	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Skidders	A2260007015	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Skidders	A2260007015	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Fellers/Bunchers	A2260007020	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Fellers/Bunchers	A2260007020	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Airport Ground Support Equipment									
Aircraft Support Equipment	A2260008005	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Aircraft Support Equipment	A2260008005	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Terminal Tractors	A2260008010	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Terminal Tractors	A2260008010	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
"A/C Tug, Narrow Body"	A2260008015	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
"A/C Tug, Narrow Body"	A2260008015	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
"A/C Tug, Wide Body"	A2260008020	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
"A/C Tug, Wide Body"	A2260008020	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Air Conditioner	A2260008025	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Air Conditioner	A2260008025	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Air Start Unit	A2260008030	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Air Start Unit	A2260008030	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Baggage Tug	A2260008035	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Baggage Tug	A2260008035	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Belt Loader	A2260008040	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Belt Loader	A2260008040	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Bobtail	A2260008045	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Bobtail	A2260008045	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Cargo Loader	A2260008050	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Cargo Loader	A2260008050	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Cart	A2260008055	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Cart	A2260008055	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Deicer	A2260008060	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Deicer	A2260008060	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Forklift	A2260008065	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Forklift	A2260008065	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Ground Power Unit	A2260008075	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Ground Power Unit	A2260008075	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Lav Cart	A2260008080	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Lav Cart	A2260008080	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Lift	A2260008090	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Lift	A2260008090	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr
Other Airport Ground Support Equipment	A2260008100	3	1.30	261	719	0.94	3.6	0.22	g/hp-hr
Other Airport Ground Support Equipment	A2260008100	16, 25	1.30	208	486	0.29	7.7	0.26	g/hp-hr

[a] All data in this Table is from the EPA's "compare.xls" spreadsheet. This spreadsheet is part of Appendix B of Reference 6.

[b] BSFC = Brake-Specific Fuel Consumption

[c] Based on values for exhaust hydrocarbons.

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a]

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Recreational Equipment									
Off-Road Motorcycles	A2265001010	16, 25, 50, 100	0.80	100	975	9.00	1.15	0.18	g/hr
Snowmobiles	A2265001020		0.80	100	975	9.00	1.15	0.18	g/hr
All Terrain Vehicles (ATVs)	A2265001030	16, 25, 50	0.80	100	975	9.00	1.15	0.18	g/hr
Minibikes	A2265001040	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Golf Carts	A2265001050	6	0.85	36.9	348	2.09	0.05	0.24	g/hp-hr
Golf Carts	A2265001050	16, 25, 50	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Specialty Vehicles Carts	A2265001060	6	0.87	36.9	429	1.98	0.73	0.24	g/hp-hr
Specialty Vehicles Carts	A2265001060	16, 25, 50	0.87	9.6	348	2.09	0.05	0.26	g/hp-hr
Construction Equipment									
Asphalt Pavers	A2265002003	6	0.74	36.9	429	1.98	0.73	0.20	g/hp-hr
Asphalt Pavers	A2265002003	16, 25	0.74	9.6	348	2.09	0.05	0.22	g/hp-hr
Asphalt Pavers	A2265002003	50, 100, 175, 250, 500	0.74	6.5	198	4.79	0.06	0.22	g/hp-hr
Tampers/Rammers	A2265002006	6	0.90	36.9	429	1.98	0.73	0.25	g/hp-hr
Tampers/Rammers	A2265002006	16, 25	0.90	9.6	348	2.09	0.05	0.27	g/hp-hr
Tampers/Rammers	A2265002006	50, 100, 175, 250, 500	0.90	6.5	198	4.79	0.06	0.27	g/hp-hr
Plate Compactors	A2265002009	6	1.00	36.9	429	1.98	0.73	0.28	g/hp-hr
Plate Compactors	A2265002009	16, 25	1.00	9.6	348	2.09	0.05	0.30	g/hp-hr
Plate Compactors	A2265002009	50, 100, 175, 250, 500	1.00	6.5	198	4.79	0.06	0.30	g/hp-hr
Concrete Pavers	A2265002012	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Concrete Pavers	A2265002012	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Concrete Pavers	A2265002012	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Rollers	A2265002015	6	0.81	36.9	429	1.98	0.73	0.22	g/hp-hr
Rollers	A2265002015	16, 25	0.81	9.6	348	2.09	0.05	0.24	g/hp-hr
Rollers	A2265002015	50, 100, 175, 250, 500	0.81	6.5	198	4.79	0.06	0.24	g/hp-hr
Scrapers	A2265002018	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Scrapers	A2265002018	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Scrapers	A2265002018	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Paving Equipment	A2265002021	6	0.81	36.9	429	1.98	0.73	0.22	g/hp-hr
Paving Equipment	A2265002021	16, 25	0.81	9.6	348	2.09	0.05	0.24	g/hp-hr
Paving Equipment	A2265002021	50, 100, 175, 250, 500	0.81	6.5	198	4.79	0.06	0.24	g/hp-hr
Surfacing Equipment	A2265002024	6	0.93	36.9	429	1.98	0.73	0.26	g/hp-hr
Surfacing Equipment	A2265002024	16, 25	0.93	9.6	348	2.09	0.05	0.28	g/hp-hr
Surfacing Equipment	A2265002024	50, 100, 175, 250, 500	0.93	6.5	198	4.79	0.06	0.28	g/hp-hr
Signal Boards	A2265002027	6	1.00	36.9	429	1.98	0.73	0.28	g/hp-hr
Signal Boards	A2265002027	16, 25	1.00	9.6	348	2.09	0.05	0.30	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Signal Boards	A2265002027	50, 100, 175, 250, 500	1.00	6.5	198	4.79	0.06	0.30	g/hp-hr
Trenchers	A2265002030	6	0.70	36.9	429	1.98	0.73	0.19	g/hp-hr
Trenchers	A2265002030	16, 25	0.70	9.6	348	2.09	0.05	0.21	g/hp-hr
Trenchers	A2265002030	50, 100, 175, 250, 500	0.70	6.5	198	4.79	0.06	0.21	g/hp-hr
Bore/Drill Rigs	A2265002033	6	0.70	36.9	429	1.98	0.73	0.19	g/hp-hr
Bore/Drill Rigs	A2265002033	16, 25	0.70	9.6	348	2.09	0.05	0.21	g/hp-hr
Bore/Drill Rigs	A2265002033	50, 100, 175, 250, 500	0.70	6.5	198	4.79	0.06	0.21	g/hp-hr
Excavators	A2265002036	6	0.55	36.9	429	1.98	0.73	0.14	g/hp-hr
Excavators	A2265002036	16, 25	0.55	9.6	348	2.09	0.05	0.16	g/hp-hr
Excavators	A2265002036	50, 100, 175, 250, 500	0.55	6.5	198	4.79	0.06	0.16	g/hp-hr
Concrete/Industrial Saws	A2265002039	6	0.81	36.9	429	1.98	0.73	0.22	g/hp-hr
Concrete/Industrial Saws	A2265002039	16, 25	0.81	9.6	348	2.09	0.05	0.24	g/hp-hr
Concrete/Industrial Saws	A2265002039	50, 100, 175, 250, 500	0.81	6.5	198	4.79	0.06	0.24	g/hp-hr
Cement and Mortar Mixers	A2265002042	6	0.93	36.9	429	1.98	0.73	0.26	g/hp-hr
Cement and Mortar Mixers	A2265002042	16, 25	0.93	9.6	348	2.09	0.05	0.28	g/hp-hr
Cement and Mortar Mixers	A2265002042	50, 100, 175, 250, 500	0.93	6.5	198	4.79	0.06	0.28	g/hp-hr
Cranes	A2265002045	6	0.59	36.9	429	1.98	0.73	0.16	g/hp-hr
Cranes	A2265002045	16, 25	0.59	9.6	348	2.09	0.05	0.17	g/hp-hr
Cranes	A2265002045	50, 100, 175, 250, 500	0.59	6.5	198	4.79	0.06	0.18	g/hp-hr
Graders	A2265002048	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Graders	A2265002048	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Graders	A2265002048	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Off-Highway Trucks	A2265002051	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Off-Highway Trucks	A2265002051	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Off-Highway Trucks	A2265002051	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Crushing/Proc. Equipment	A2265002054	6	0.70	36.9	429	1.98	0.73	0.19	g/hp-hr
Crushing/Proc. Equipment	A2265002054	16, 25	0.70	9.6	348	2.09	0.05	0.21	g/hp-hr
Crushing/Proc. Equipment	A2265002054	50, 100, 175, 250, 500	0.70	6.5	198	4.79	0.06	0.21	g/hp-hr
Rough Terrain Forklifts	A2265002057	6	0.60	36.9	429	1.98	0.73	0.16	g/hp-hr
Rough Terrain Forklifts	A2265002057	16, 25	0.60	9.6	348	2.09	0.05	0.18	g/hp-hr
Rough Terrain Forklifts	A2265002057	50, 100, 175, 250, 500	0.60	6.5	198	4.79	0.06	0.18	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Rubber Tired Loaders	A2265002060	6	0.60	36.9	429	1.98	0.73	0.16	g/hp-hr
Rubber Tired Loaders	A2265002060	16, 25	0.60	9.6	348	2.09	0.05	0.18	g/hp-hr
Rubber Tired Loaders	A2265002060	50, 100, 175, 250, 500	0.60	6.5	198	4.79	0.06	0.18	g/hp-hr
Rubber Tired Dozers	A2265002063	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Rubber Tired Dozers	A2265002063	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Rubber Tired Dozers	A2265002063	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Tractors/Loaders/Backhoes	A2265002066	6	0.55	36.9	429	1.98	0.73	0.14	g/hp-hr
Tractors/Loaders/Backhoes	A2265002066	16, 25	0.55	9.6	348	2.09	0.05	0.16	g/hp-hr
Tractors/Loaders/Backhoes	A2265002066	50, 100, 175, 250, 500	0.55	6.5	198	4.79	0.06	0.16	g/hp-hr
Crawler Tractors	A2265002069	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Crawler Tractors	A2265002069	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Crawler Tractors	A2265002069	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Skid Steer Loaders	A2265002072	6	0.74	36.9	429	1.98	0.73	0.20	g/hp-hr
Skid Steer Loaders	A2265002072	16, 25	0.74	9.6	348	2.09	0.05	0.22	g/hp-hr
Skid Steer Loaders	A2265002072	50, 100, 175, 250, 500	0.74	6.5	198	4.79	0.06	0.22	g/hp-hr
Off-Highway Tractors	A2265002075	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Off-Highway Tractors	A2265002075	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Off-Highway Tractors	A2265002075	50, 100, 175, 250, 500	----	6.5	198	4.79	0.06	----	g/hp-hr
Dumpers/Tenders	A2265002078	6	0.83	36.9	429	1.98	0.73	0.23	g/hp-hr
Dumpers/Tenders	A2265002078	16, 25, 50	0.83	9.6	348	2.09	0.05	0.25	g/hp-hr
Dumpers/Tenders	A2265002078	100, 175, 250, 500	0.83	6.5	198	4.79	0.06	0.25	g/hp-hr
Other Construction Equipment	A2265002081	6	0.55	36.9	429	1.98	0.73	0.14	g/hp-hr
Other Construction Equipment	A2265002081	16, 25, 50	0.55	9.6	348	2.09	0.05	0.16	g/hp-hr
Other Construction Equipment	A2265002081	100, 175, 250, 500	0.55	6.5	198	4.79	0.06	0.16	g/hp-hr
Industrial Equipment									
Aerial Lifts	A2265003010	6	0.74	36.9	429	1.98	0.73	0.20	g/hp-hr
Aerial Lifts	A2265003010	16, 25	0.74	9.6	348	2.09	0.05	0.22	g/hp-hr
Aerial Lifts	A2265003010	50, 100, 175, 250, 500	0.74	6.48	199	5.16	0.06	0.22	g/hp-hr
Forklifts	A2265003020	6	0.65	36.9	429	1.98	0.73	0.17	g/hp-hr
Forklifts	A2265003020	16, 25	0.65	9.6	348	2.09	0.05	0.19	g/hp-hr
Forklifts	A2265003020	50, 100, 175, 250, 500	0.65	6.48	199	5.16	0.06	0.20	g/hp-hr
Sweepers/Scrubbers	A2265003030	6	0.70	36.9	429	1.98	0.73	0.19	g/hp-hr
Sweepers/Scrubbers	A2265003030	16, 25	0.70	9.6	348	2.09	0.05	0.21	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Sweepers/Scrubbers	A2265003030	50, 100, 175, 250, 500	0.70	6.48	199	5.16	0.06	0.21	g/hp-hr
Other General Industrial Equipment	A2265003040	6	0.70	36.9	429	1.98	0.73	0.19	g/hp-hr
Other General Industrial Equipment	A2265003040	16, 25	0.70	9.6	348	2.09	0.05	0.21	g/hp-hr
Other General Industrial Equipment	A2265003040	50, 100, 175, 250, 500	0.70	6.48	199	5.16	0.06	0.21	g/hp-hr
Other Material Handling Equipment	A2265003050	6	0.63	36.9	429	1.98	0.73	0.17	g/hp-hr
Other Material Handling Equipment	A2265003050	16, 25	0.63	9.6	348	2.09	0.05	0.19	g/hp-hr
Other Material Handling Equipment	A2265003050	50, 100, 175, 250, 500	0.63	6.48	199	5.16	0.06	0.19	g/hp-hr
Industrial Tractors	A2265003060		0.63	36.9	429	1.98	0.73	0.17	g/hp-hr
Industrial Tractors	A2265003060	16, 25	0.63	9.6	348	2.09	0.05	0.19	g/hp-hr
Industrial Tractors	A2265003060	50, 100, 175, 250, 500	0.63	6.48	199	5.16	0.06	0.19	g/hp-hr
Lawn and Garden Equipment									
Lawn Mowers	A2265004010, A2265004011	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Lawn Mowers	A2265004010, A2265004011	16, 25	1.09	9.6	348	2.09	0.05	0.33	g/hp-hr
Lawn Mowers	A2265004010, A2265004011	50, 100, 175, 250, 500	1.09	6.48	199	5.16	0.06	0.33	g/hp-hr
Tillers	A2265004015, A2265004016	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Tillers	A2265004015, A2265004016	16, 25	1.09	9.6	348	2.09	0.05	0.33	g/hp-hr
Tillers	A2265004015, A2265004016	50, 100, 175, 250, 500	1.09	6.48	199	5.16	0.06	0.33	g/hp-hr
Chainsaws < 6 hp	A2265004020	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Trimmers/Edgers/Brush Cutters	A2265004025, A2265004026	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Trimmers/Edgers/Brush Cutters	A2265004025, A2265004026	16, 25	1.09	9.6	348	2.09	0.05	0.33	g/hp-hr
Trimmers/Edgers/Brush Cutters	A2265004025, A2265004026	50, 100, 175, 250, 500	1.09	6.48	199	5.16	0.06	0.33	g/hp-hr
Leaf Blowers/Vacuums	A2265004030, A2265004031	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Leaf Blowers/Vacuums	A2265004030, A2265004031	16, 25	1.09	9.6	348	2.09	0.05	0.33	g/hp-hr
Leaf Blowers/Vacuums	A2265004030, A2265004031	50, 100, 175, 250, 500	1.09	6.48	199	5.16	0.06	0.33	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Snowblowers	A2265004035, A2265004036	6	0.93	37.0	429	1.98	0.73	0.26	g/hp-hr
Snowblowers	A2265004035, A2265004036	16, 25	0.93	9.6	348	2.09	0.05	0.28	g/hp-hr
Snowblowers	A2265004035, A2265004036	50, 100, 175, 250, 500	0.93	6.48	199	5.16	0.06	0.28	g/hp-hr
Rear Engine Riding Mowers	A2265004040, A2265004041	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Rear Engine Riding Mowers	A2265004040, A2265004041	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Rear Engine Riding Mowers	A2265004040, A2265004041	50, 100, 175, 250, 500	0.85	6.48	199	5.16	0.06	0.26	g/hp-hr
Front Engine Riding Mowers	A2265004045, A2265004046	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Front Engine Riding Mowers	A2265004045, A2265004046	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Front Engine Riding Mowers	A2265004045, A2265004046	50, 100, 175, 250, 500	0.85	6.48	199	5.16	0.06	0.26	g/hp-hr
Shredders < 6 hp	A2265004050, A2265004051	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Lawn & Garden Tractors	A2265004055, A2265004056	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Lawn & Garden Tractors	A2265004055, A2265004056	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Lawn & Garden Tractors	A2265004055, A2265004056	50, 100, 175, 250, 500	0.85	6.48	199	5.16	0.06	0.26	g/hp-hr
Wood Splitters	A2265004060, A2265004061	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Wood Splitters	A2265004060, A2265004061	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Wood Splitters	A2265004060, A2265004061	50, 100, 175, 250, 500	0.85	6.48	199	5.16	0.06	0.26	g/hp-hr
Chippers/Stump Grinders	A2265004065	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Chippers/Stump Grinders	A2265004065	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Chippers/Stump Grinders	A2265004065	50, 100, 175, 250, 500	0.85	6.48	199	5.16	0.06	0.26	g/hp-hr
Commercial Turf Equipment	A2265004070, A2265004071	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Commercial Turf Equipment	A2265004070, A2265004071	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Commercial Turf Equipment	A2265004070, A2265004071	50, 100, 175, 250, 500	0.85	6.48	199	5.16	0.06	0.26	g/hp-hr
Other Lawn & Garden Equipment	A2265004075, A2265004076	6	1.09	37.0	429	1.98	0.73	0.31	g/hp-hr
Other Lawn & Garden Equipment	A2265004075, A2265004076	16, 25	1.09	9.6	348	2.09	0.05	0.33	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Other Lawn & Garden Equipment	A2265004075, A2265004076	50, 100, 175, 250, 500	1.09	6.48	199	5.16	0.06	0.33	g/hp-hr
Agricultural Equipment									
2-Wheel Tractors	A2265005010	6	0.93	37	429	1.98	0.73	0.26	g/hp-hr
2-Wheel Tractors	A2265005010	16, 25, 50, 100, 175, 250, 500	0.93	9.6	348	2.09	0.05	0.28	g/hp-hr
Agricultural Tractors	A2265005015	6	0.55	37.0	429	1.98	0.73	0.14	g/hp-hr
Agricultural Tractors	A2265005015	16, 25	0.55	9.6	348	2.09	0.05	0.16	g/hp-hr
Agricultural Tractors	A2265005015	50, 100, 175, 250, 500	0.55	7.18	218	5.24	0.06	0.16	g/hp-hr
Agricultural Mowers	A2265005030	6	0.85	37.0	429	1.98	0.73	0.24	g/hp-hr
Agricultural Mowers	A2265005030	16, 25	0.85	9.6	348	2.09	0.05	0.25	g/hp-hr
Agricultural Mowers	A2265005030	50, 100, 175, 250, 500	0.85	7.18	218	5.24	0.06	0.26	g/hp-hr
Sprayers	A2265005035	6	0.76	37.0	429	1.98	0.73	0.21	g/hp-hr
Sprayers	A2265005035	16, 25	0.76	9.6	348	2.09	0.05	0.23	g/hp-hr
Sprayers	A2265005035	50, 100, 175, 250, 500	0.76	7.18	218	5.24	0.06	0.23	g/hp-hr
Tillers > 6 hp	A2265005040	6	0.90	37.0	429	1.98	0.73	0.25	g/hp-hr
Tillers > 6 hp	A2265005040	16, 25	0.90	9.6	348	2.09	0.05	0.27	g/hp-hr
Tillers > 6 hp	A2265005040	50, 100, 175, 250, 500	0.90	7.18	218	5.24	0.06	0.27	g/hp-hr
Hydro Power Units	A2265005050	6	0.73	37.0	429	1.98	0.73	0.20	g/hp-hr
Hydro Power Units	A2265005050	16, 25	0.73	9.6	348	2.09	0.05	0.22	g/hp-hr
Hydro Power Units	A2265005050	50, 100, 175, 250, 500	0.73	7.18	218	5.24	0.06	0.22	g/hp-hr
Other Agricultural Equipment	A2265005055	6	0.73	37.0	429	1.98	0.73	0.20	g/hp-hr
Other Agricultural Equipment	A2265005055	16, 25	0.73	9.6	348	2.09	0.05	0.22	g/hp-hr
Other Agricultural Equipment	A2265005055	50, 100, 175, 250, 500	0.73	7.18	218	5.24	0.06	0.22	g/hp-hr
Commercial Equipment									
Generator Sets	A2265006005	6	0.87	37.0	429	1.98	0.73	0.24	g/hp-hr
Generator Sets	A2265006005	16, 25	0.87	9.6	348	2.09	0.05	0.26	g/hp-hr
Generator Sets	A2265006005	50, 100, 175, 250, 500	0.87	6.48	199	5.16	0.06	0.26	g/hp-hr
Pumps	A2265006010	6	0.87	37.0	429	1.98	0.73	0.24	g/hp-hr
Pumps	A2265006010	16, 25	0.87	9.6	348	2.09	0.05	0.26	g/hp-hr
Pumps	A2265006010	50, 100, 175, 250, 500	0.87	6.48	199	5.16	0.06	0.26	g/hp-hr
Air Compressors	A2265006015	6	0.87	37.0	429	1.98	0.73	0.24	g/hp-hr
Air Compressors	A2265006015	16, 25	0.87	9.6	348	2.09	0.05	0.26	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Air Compressors	A2265006015	50, 100, 175, 250, 500	0.87	6.48	199	5.16	0.06	0.26	g/hp-hr
Gas Compressors	A2265006020	6	0.87	37.0	429	1.98	0.73	0.24	g/hp-hr
Gas Compressors	A2265006020	16, 25	0.87	9.6	348	2.09	0.05	0.26	g/hp-hr
Gas Compressors	A2265006020	50, 100, 175, 250, 500	0.87	6.48	199	5.16	0.06	0.26	g/hp-hr
Welders	A2265006025	6	0.80	37.0	429	1.98	0.73	0.22	g/hp-hr
Welders	A2265006025	16, 25	0.80	9.6	348	2.09	0.05	0.24	g/hp-hr
Welders	A2265006025	50, 100, 175, 250, 500	0.80	6.48	199	5.16	0.06	0.24	g/hp-hr
Pressure Washers	A2265006030	6	0.87	37.0	429	1.98	0.73	0.24	g/hp-hr
Pressure Washers	A2265006030	16, 25	0.87	9.6	348	2.09	0.05	0.26	g/hp-hr
Pressure Washers	A2265006030	50, 100, 175, 250, 500	0.87	6.48	199	5.16	0.06	0.26	g/hp-hr
Logging Equipment									
Shredders > 6 hp	A2265007010	6	0.90	37.0	429	1.98	0.73	0.25	g/hp-hr
Shredders > 6 hp	A2265007010	16, 25	0.90	9.6	348	2.09	0.05	0.27	g/hp-hr
Shredders > 6 hp	A2265007010	50, 100, 175, 250, 500	0.90	6.48	199	5.16	0.06	0.27	g/hp-hr
Skidders	A2265007015	6	0.90	37.0	429	1.98	0.73	0.25	g/hp-hr
Skidders	A2265007015	16, 25	0.90	9.6	348	2.09	0.05	0.27	g/hp-hr
Skidders	A2265007015	50, 100, 175, 250, 500	0.90	6.48	199	5.16	0.06	0.27	g/hp-hr
Fellers/Bunchers	A2265007020	6	0.90	37.0	429	1.98	0.73	0.25	g/hp-hr
Fellers/Bunchers	A2265007020	16, 25	0.90	9.6	348	2.09	0.05	0.27	g/hp-hr
Fellers/Bunchers	A2265007020	50, 100, 175, 250, 500	0.90	6.48	199	5.16	0.06	0.27	g/hp-hr
Airport Ground Support Equipment									
Aircraft Support Equipment	A2265008005	6	0.70	36.9	429	1.98	0.73	0.19	g/hp-hr
Aircraft Support Equipment	A2265008005	16, 25	0.70	9.6	348	2.09	0.05	0.21	g/hp-hr
Aircraft Support Equipment	A2265008005	50, 100, 175, 250, 500	0.70	6.48	199	5.16	0.06	0.21	g/hp-hr
Terminal Tractors	A2265008010	6	0.55	36.9	429	1.98	0.73	0.14	g/hp-hr
Terminal Tractors	A2265008010	16, 25	0.55	9.6	348	2.09	0.05	0.16	g/hp-hr
Terminal Tractors	A2265008010	50, 100, 175, 250, 500	0.55	6.48	199	5.16	0.06	0.16	g/hp-hr
"A/C Tug, Narrow Body"	A2265008015	6	----	36.9	429	1.98	0.73	----	g/hp-hr
"A/C Tug, Narrow Body"	A2265008015	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
"A/C Tug, Narrow Body"	A2265008015	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
"A/C Tug, Wide Body"	A2265008020	6	----	36.9	429	1.98	0.73	----	g/hp-hr
"A/C Tug, Wide Body"	A2265008020	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
"A/C Tug, Wide Body"	A2265008020	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Air Conditioner	A2265008025	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Air Conditioner	A2265008025	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Air Conditioner	A2265008025	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Air Start Unit	A2265008030	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Air Start Unit	A2265008030	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Air Start Unit	A2265008030	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Baggage Tug	A2265008035	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Baggage Tug	A2265008035	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Baggage Tug	A2265008035	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Belt Loader	A2265008040	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Belt Loader	A2265008040	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Belt Loader	A2265008040	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Bobtail	A2265008045	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Bobtail	A2265008045	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Bobtail	A2265008045	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Cargo Loader	A2265008050	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Cargo Loader	A2265008050	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Cargo Loader	A2265008050	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Cart	A2265008055	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Cart	A2265008055	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Cart	A2265008055	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Deicer	A2265008060	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Deicer	A2265008060	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Deicer	A2265008060	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Forklift	A2265008065	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Forklift	A2265008065	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Forklift	A2265008065	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Ground Power Unit	A2265008075	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Ground Power Unit	A2265008075	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Ground Power Unit	A2265008075	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr

Table 7-3. Criteria Pollutant Emission Factors for 4-Stroke Gasoline Nonroad Vehicles/Equipment[a] (Cont'd)

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
Lav Cart	A2265008080	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Lav Cart	A2265008080	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Lav Cart	A2265008080	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Lift	A2265008090	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Lift	A2265008090	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Lift	A2265008090	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr
Other Airport Ground Support Equipment	A2265008100	6	----	36.9	429	1.98	0.73	----	g/hp-hr
Other Airport Ground Support Equipment	A2265008100	16, 25	----	9.6	348	2.09	0.05	----	g/hp-hr
Other Airport Ground Support Equipment	A2265008100	50, 100, 175, 250, 500	----	6.48	199	5.16	0.06	----	g/hp-hr

[a] All data in this Table is from the EPA's "compare.xls" spreadsheet. This spreadsheet is part of Appendix B of Reference 6.

[b] BSFC = Brake-Specific Fuel Consumption

[c] Based on values for exhaust hydrocarbons.

Table 7-4. Criteria Pollutant Emission Factors for Liquid Petroleum Gas and Compressed Natural Gas Vehicles/Equipment[a]

Description	SCC	EPA HP Classes	BSFC[b] (lb/hp-hr)	Emission Factors					
				VOC[c]	CO	NO_X	PM	SO_X	Units
LPG Vehicles/Equipment									
Aerial Lifts	A2267003010	----	0.65	3	63.7	17.9	0.05	0.02	g/hp-hr
Fork Lifts	A2267003020	----	0.65	3	63.7	17.9	0.05	0.02	g/hp-hr
Sweeper Scrubbers	A2267003030	----	0.70	3	63.7	17.9	0.05	0.02	g/hp-hr
Pumps	A2267006010	----	0.93	4.28	113	7.04	0.05	0.03	g/hp-hr
Gas Compressors	A2267006020	----	0.93	4.28	113	7.04	0.05	0.03	g/hp-hr
Terminal Tractors	A2267008010	----	0.55	3	63.7	17.9	0.05	0.01	g/hp-hr
CNG Vehicles/Equipment									
Aerial Lifts	A2268003010	----	0.70	3	63.7	17.9	0.05	0.02	g/hp-hr
Fork Lifts	A2268003020	----	0.70	3	63.7	17.9	0.05	0.02	g/hp-hr
Sweeper Scrubbers	A2268003030	----	0.70	3	63.7	17.9	0.05	0.02	g/hp-hr
Pumps	A2268006010	----	0.93	4.28	113	7.04	0.05	0.03	g/hp-hr
Gas Compressors	A2268006020	----	0.93	4.28	113	7.04	0.05	0.03	g/hp-hr
Terminal Tractors	A2268008010	----	0.55	3	63.7	17.9	0.05	0.01	g/hp-hr

[a] All data in this Table is from the EPA's "compare.xls" spreadsheet. This spreadsheet is part of Appendix B of Reference 6.

[b] BSFC = Brake-Specific Fuel Consumption

[c] Based on values for exhaust hydrocarbons.

Table 7-5. Types of Diesel Nonroad Vehicles/Equipment and Corresponding Table 7-6 Emission Factor Groups

Description	SCC	Emission Factor Group From Table 7-6
Recreational Equipment		
Specialty Vehicles Carts	A2270001060	Group 3
Construction Equipment		
Asphalt Pavers	A2270002003	Group 4
Plate Compactors	A2270002009	Group 3
Rollers	A2270002015	Group 4
Scrapers	A2270002018	Group 4
Paving Equipment	A2270002021	Group 4
Surfacing Equipment	A2270002024	Group 4
Signal Boards	A2270002027	Group 1
Trenchers	A2270002030	Group 3
Bore/Drill Rigs	A2270002033	Group 4
Excavators	A2270002036	Group 3
Concrete/Industrial Saws	A2270002039	Group 4
Cement and Mortar Mixers	A2270002042	Group 1
Cranes	A2270002045	Group 4
Graders	A2270002048	Group 4
Off-Highway Trucks	A2270002051	Group 3
Crushing/Proc. Equipment	A2270002054	Group 4
Rough Terrain Forklifts	A2270002057	Group 3
Rubber Tired Loaders	A2270002060	Group 3
Rubber Tired Dozers	A2270002063	Group 4
Tractors/Loaders/Backhoes	A2270002066	Group 3
Crawler Tractors	A2270002069	Group 4
Skid Steer Loaders	A2270002072	Group 3
Off-Highway Tractors	A2270002075	Group 3
Dumpers/Tenders	A2270002078	Group 3
Other Construction Equipment	A2270002081	Group 4
Industrial Equipment		
Aerial Lifts	A2270003010	Group 4
Forklifts	A2270003020	Group 3
Sweepers/Scrubbers	A2270003030	Group 2
Other General Industrial Equipment	A2270003040	Group 1
Other Material Handling	A2270003050	Group 3
Industrial Tractors	A2270003060	Group 1
Lawn and Garden Equipment		
Leaf Blowers/Vacuums	A2270004030, A2270004031	Group 1
Snowblowers	A2270004035, A2270004036	Group 1

Table 7-5. Types of Diesel Nonroad Vehicles/Equipment and Corresponding Table 7-6 Emission Factor Groups (Cont'd)

Description	SCC	Emission Factor Group From Table 7-6
Rear Engine Riding Mowers	A2270004040, A2270004041	Group 1
Front Engine Riding Mowers	A2270004045, A2270004046	Group 1
Shredders < 6 hp	A2270004050, A2270004051	Group 1
Lawn & Garden Tractors	A2270004055, A2270004056	Group 1
Commercial Turf Equipment	A2270004071	Group 1
Other Lawn & Garden Equipment	A2270004075, A2270004076	Group 1
Agricultural Equipment		
2-Wheel Tractors	A2270005010	Group 2
Agricultural Tractors	A2270005015	Group 2
Agricultural Mowers	A2270005030	Group 2
Sprayers	A2270005035	Group 2
Tillers > 6 hp	A2270005040	Group 2
Hydro Power Units	A2270005050	Group 1
Other Agricultural Equipment	A2270005055	Group 2
Irrigation Sets	A2270005060	Group 1
Commercial Equipment		
Generator Sets	A2270006005	Group 1
Pumps	A2270006010	Group 1
Air Compressors	A2270006015	Group 1
Gas Compressors	A2270006020	Group 1
Welders	A2270006025	Group 1
Pressure Washers	A2270006030	Group 1
Logging Equipment		
Shredders > 6 hp	A2270007010	Group 1
Skidders	A2270007015	Group 4
Fellers/Bunchers	A2270007020	Group 3
Airport Ground Support Equipment		
Aircraft Support Equipment	A2270008005	Group 3
Terminal Tractors	A2270008010	Group 3

Table 7-6. Criteria Pollutant Emission Factors for Nonroad Diesel Engines[a]

Engine Power (hp)	BSFC[b] (lb/hp-hr)	Model Year	Emission Factors (g/hp-hr)				
			VOC[c]	CO	NO_X	PM	SO_X
Group 1							
>0 to 11	0.408	pre 1988	1.5	5.0	10.0	1.0	1.18
		1988 to 1999	1.5	5.0	10.0	1.0	1.18
		2000 to 2004	1.6	5.6	5.9	0.75	1.18
		2005 and later	0.6	5.6	5.0	0.75	1.19
>11 to 16	0.408	pre 1988	1.5	5.0	10.0	1.0	1.18
		1988 to 1999	1.5	5.0	10.0	1.0	1.18
		2000 to 2004	0.7	2.0	5.2	0.6	1.19
		2005 and later	0.6	2.0	5.0	0.6	1.19
>16 to 25	0.408	pre 1988	1.8	5.0	6.9	0.8	1.18
		1988 to 1999	1.8	5.0	6.9	0.8	1.18
		2000 to 2004	0.7	2.0	5.2	0.6	1.19
		2005 and later	0.6	2.0	5.0	0.6	1.19
>25 to 50	0.408	pre 1988	1.8	5.0	6.9	0.8	1.18
		1988 to 1998	1.8	5.0	6.9	0.8	1.18
		1999 to 2003	0.8	2.5	5.5	0.6	1.19
		2004 and later	0.6	2.5	5.0	0.6	1.19
>50 to 100	0.408	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1997	0.99	3.49	8.30	0.72	1.19
		1998-2003	0.7	1.0	6.9	0.72	1.19
		2004 to 2007	0.4	1.0	5.2	0.72	1.19
		2008 and later	0.2	1.0	3.3	0.72	1.19
>100 to 175	0.367	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1996	0.68	2.70	8.38	0.40	1.07
		1997 to 2002	0.4	1.0	6.9	0.40	1.07
		2003 to 2006	0.4	1.0	4.5	0.40	1.07
		2007 and later	0.2	1.0	2.8	0.40	1.07
>175 to 300	0.367	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.68	2.70	8.38	0.40	1.07
		1996 to 2002	0.4	1.0	6.9	0.40	1.07
		2003 to 2005	0.4	1.0	4.5	0.40	1.07
		2006 and later	0.2	1.0	2.8	0.40	1.07
>300 to 600	0.367	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.68	2.70	8.38	0.40	1.07
		1996 to 2000	0.4	1.0	6.9	0.40	1.07
		2001 to 2005	0.4	1.0	4.5	0.40	1.07
		2006 and later	0.2	1.0	2.8	0.40	1.07
>600 to 750	0.367	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.68	2.70	8.38	0.40	1.07
		1996 to 2001	0.4	1.0	6.9	0.40	1.07
		2002 to 2005	0.4	1.0	4.5	0.40	1.07
		2006 and later	0.2	1.0	2.8	0.40	1.07
>750	0.367	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1999	0.68	2.70	8.38	0.40	1.07
		2000 to 2005	0.4	1.0	6.9	0.40	1.07
		2006 and later	0.4	1.0	4.5	0.40	1.07

Table 7-6. Criteria Pollutant Emission Factors for Nonroad Diesel Engines[a] (Cont'd)

Engine Power (hp)	BSFC[b] (lb/hp-hr)	Model Year	Emission Factors (g/hp-hr)				
			VOC[c]	CO	NO_X	PM	SO_X
Group 2							
>0 to 11	0.400	pre 1988	1.3	2.1	9.9	0.6	1.16
		1988 to 1999	1.3	2.1	9.9	0.6	1.16
		2000 to 2004	1.4	2.4	5.8	0.5	1.16
		2005 and later	0.5	2.4	5.0	0.5	1.17
>11 to 16	0.400	pre 1988	1.3	2.1	9.9	0.6	1.16
		1988 to 1999	1.3	2.1	9.9	0.6	1.16
		2000 to 2004	0.6	0.8	5.1	0.4	1.17
		2005 and later	0.5	0.8	5.0	0.4	1.17
>16 to 25	0.400	pre 1988	1.6	2.1	6.8	0.5	1.16
		1988 to 1999	1.6	2.1	6.8	0.5	1.16
		2000 to 2004	0.6	0.8	5.1	0.4	1.17
		2005 and later	0.5	0.8	5.0	0.4	1.17
>25 to 50	0.400	pre 1988	1.6	2.1	6.8	0.5	1.16
		1988 to 1998	1.6	2.1	6.8	0.5	1.16
		1999 to 2003	0.7	1.1	5.4	0.4	1.17
		2004 and later	0.5	1.1	5.0	0.4	1.17
>50 to 100	0.400	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1997	0.9	1.5	8.2	0.5	1.16
		1998-2003	0.6	0.4	6.8	0.5	1.17
		2004 to 2007	0.4	0.4	5.1	0.5	1.17
		2008 and later	0.2	0.4	3.3	0.5	1.17
>100 to 175	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1996	0.6	1.1	8.3	0.3	1.05
		1997 to 2002	0.4	0.4	6.8	0.3	1.05
		2003 to 2006	0.4	0.4	4.5	0.3	1.05
		2007 and later	0.2	0.4	2.8	0.3	1.05
>175 to 300	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.6	1.1	8.3	0.3	1.05
		1996 to 2002	0.4	0.4	6.8	0.3	1.05
		2003 to 2005	0.4	0.4	4.5	0.3	1.05
		2006 and later	0.2	0.4	2.8	0.3	1.05
>300 to 600	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.6	1.1	8.3	0.3	1.05
		1996 to 2000	0.4	0.4	6.8	0.3	1.05
		2001 to 2005	0.4	0.4	4.5	0.3	1.05
		2006 and later	0.2	0.4	2.8	0.3	1.05
>600 to 750	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.6	1.1	8.3	0.3	1.05
		1996 to 2001	0.4	0.4	6.8	0.3	1.05
		2002 to 2005	0.4	0.4	4.5	0.3	1.05
		2006 and later	0.2	0.4	2.8	0.3	1.05
>750	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1999	0.6	1.1	8.3	0.3	1.05
		2000 to 2005	0.4	0.4	6.8	0.3	1.05
		2006 and later	0.4	0.4	4.5	0.3	1.05

Table 7-6. Criteria Pollutant Emission Factors for Nonroad Diesel Engines[a] (Cont'd)

Engine Power (hp)	BSFC[b] (lb/hp-hr)	Model Year	Emission Factors (g/hp-hr)				
			VOC[c]	CO	NO_X	PM	SO_X
Group 3							
>0 to 11	0.481	pre 1988	3.3	11.6	10.3	2.0	1.39
		1988 to 1999	3.3	11.6	10.3	2.0	1.39
		2000 to 2004	3.5	12.9	6.1	1.5	1.39
		2005 and later	1.3	12.9	5.2	1.5	1.40
>11 to 16	0.481	pre 1988	3.3	11.6	10.3	2.0	1.39
		1988 to 1999	3.3	11.6	10.3	2.0	1.39
		2000 to 2004	1.5	4.6	5.4	1.2	1.40
		2005 and later	1.3	4.6	5.2	1.2	1.40
>16 to 25	0.481	pre 1988	3.9	11.6	7.1	1.6	1.38
		1988 to 1999	3.9	11.6	7.1	1.6	1.12
		2000 to 2004	1.5	4.6	5.4	1.2	1.12
		2005 and later	1.3	4.6	5.2	1.2	1.12
>25 to 50	0.481	pre 1988	3.9	11.6	7.1	1.6	1.38
		1988 to 1998	3.9	11.6	7.1	1.6	1.38
		1999 to 2003	1.8	5.8	5.7	1.2	1.40
		2004 and later	1.3	5.8	5.2	1.2	1.40
>50 to 100	0.481	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1997	2.2	8.1	8.5	1.5	1.40
		1998-2003	1.5	2.3	7.1	1.5	1.40
		2004 to 2007	0.9	2.3	5.4	1.5	1.40
		2008 and later	0.4	2.3	3.4	1.5	1.41
>100 to 175	0.433	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1996	1.5	6.2	8.6	0.8	1.26
		1997 to 2002	0.9	2.3	7.1	0.8	1.26
		2003 to 2006	0.9	2.3	4.6	0.8	1.26
		2007 and later	0.4	2.3	2.9	0.8	1.27
>175 to 300	0.433	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	1.5	6.2	8.6	0.8	1.26
		1996 to 2002	0.9	2.3	7.1	0.8	1.26
		2003 to 2005	0.9	2.3	4.6	0.8	1.26
		2006 and later	0.4	2.3	2.9	0.8	1.27
>300 to 600	0.433	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	1.5	6.2	8.6	0.8	1.26
		1996 to 2000	0.9	2.3	7.1	0.8	1.26
		2001 to 2005	0.9	2.3	4.6	0.8	1.26
		2006 and later	0.4	2.3	2.9	0.8	1.27
>600 to 750	0.433	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	1.5	6.2	8.6	0.8	1.26
		1996 to 2001	0.9	2.3	7.1	0.8	1.26
		2002 to 2005	0.9	2.3	4.6	0.8	1.26
		2006 and later	0.4	2.3	2.9	0.8	1.27
>750	0.433	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1999	1.5	6.2	8.6	0.8	1.26
		2000 to 2005	0.9	2.3	7.1	0.8	1.26
		2006 and later	0.9	2.3	4.6	0.8	1.26

Table 7-6. Criteria Pollutant Emission Factors for Nonroad Diesel Engines[a] (Cont'd)

Engine Power (hp)	BSFC[b] (lb/hp-hr)	Model Year	Emission Factors (g/hp-hr)				
			VOC[c]	CO	NO_X	PM	SO_X
Group 4							
>0 to 11	0.400	pre 1988	1.4	6.4	9.9	1.2	1.16
		1988 to 1999	1.4	6.4	9.9	1.2	1.16
		2000 to 2004	1.5	7.1	5.8	0.9	1.16
		2005 and later	0.6	7.1	5.0	0.9	1.17
>11 to 16	0.400	pre 1988	1.4	6.4	9.9	1.2	1.16
		1988 to 1999	1.4	6.4	9.9	1.2	1.16
		2000 to 2004	0.7	2.5	5.1	0.7	1.17
		2005 and later	0.6	2.5	5.0	0.7	1.17
>16 to 25	0.400	pre 1988	1.7	6.4	6.8	1.0	1.16
		1988 to 1999	1.7	6.4	6.8	1.0	1.16
		2000 to 2004	0.7	2.5	5.1	0.7	1.17
		2005 and later	0.6	2.5	5.0	0.7	1.17
>25 to 50	0.400	pre 1988	1.7	6.4	6.8	1.0	1.16
		1988 to 1998	1.7	6.4	6.8	1.0	1.16
		1999 to 2003	0.7	3.2	5.4	0.7	1.17
		2004 and later	0.6	3.2	5.0	0.7	1.17
>50 to 100	0.400	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1997	0.9	4.4	8.2	0.9	1.16
		1998-2003	0.7	1.3	6.8	0.9	1.17
		2004 to 2007	0.4	1.3	5.1	0.9	1.17
		2008 and later	0.2	1.3	3.3	0.9	1.17
>100 to 175	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1996	0.6	3.4	8.3	0.5	1.05
		1997 to 2002	0.4	1.3	6.8	0.5	1.05
		2003 to 2006	0.4	1.3	4.5	0.5	1.05
		2007 and later	0.2	1.3	2.8	0.5	1.05
>175 to 300	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.6	3.4	8.3	0.5	1.05
		1996 to 2002	0.4	1.3	6.8	0.5	1.05
		2003 to 2005	0.4	1.3	4.5	0.5	1.05
		2006 and later	0.2	1.3	2.8	0.5	1.05
>300 to 600	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.6	3.4	8.3	0.5	1.05
		1996 to 2000	0.4	1.3	6.8	0.5	1.05
		2001 to 2005	0.4	1.3	4.5	0.5	1.05
		2006 and later	0.2	1.3	2.8	0.5	1.05
>600 to 750	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1995	0.6	3.4	8.3	0.5	1.05
		1996 to 2001	0.4	1.3	6.8	0.5	1.05
		2002 to 2005	0.4	1.3	4.5	0.5	1.05
		2006 and later	0.2	1.3	2.8	0.5	1.05
>750	0.360	pre 1988	Vary by application. Use values in Table 7-7.				
		1988 to 1999	0.6	3.4	8.3	0.5	1.05
		2000 to 2005	0.4	1.3	6.8	0.5	1.05
		2006 and later	0.4	1.3	4.5	0.5	1.05

[a] All data in this table is from Reference 5.

[b] BSFC = Brake-Specific Fuel Consumption

[c] Based on values for hydrocarbons.

Table 7-7. Criteria Pollutant Emission Factors for Specific Types of Nonroad Diesel Vehicles/Equipment[a,b]

Description	Emission Factors (g/hp-hr)				
	VOC[c]	CO	NO_X	PM	SO_X
Recreational Equipment					
Specialty Vehicles Carts	1.22	5.00	8.00	1.00	0.93
Construction Equipment					
Asphalt Pavers	0.61	3.20	10.30	0.90	0.93
Plate Compactors	0.82	3.10	9.30	0.90	0.93
Concrete Pavers	1.12	4.57	10.02	0.90	0.93
Rollers	0.82	3.10	9.30	0.78	1.00
Scrapers	0.71	5.00	8.70	1.26	0.90
Paving Equipment	1.13	4.60	11.01	0.90	0.90
Signal Boards	1.22	5.00	8.00	1.00	0.93
Trenchers	1.57	9.14	10.02	1.44	0.93
Bore/Drill Rigs	1.44	9.20	11.01	1.44	0.93
Excavators	0.70	5.20	10.75	1.44	0.93
Concrete/Industrial Saws	1.44	9.20	11.01	1.44	0.93
Cement and Mortar Mixers	1.03	4.60	11.01	0.90	0.93
Cranes	1.29	4.20	10.30	1.44	0.93
Graders	1.57	3.80	9.60	1.00	0.87
Off-Highway Trucks	0.86	2.80	9.60	0.80	0.89
Crushing/Proc. Equipment	1.44	9.20	11.01	1.44	0.93
Rough Terrain Forklifts	1.7	10.00	8.00	1.60	0.93
Rubber Tired Loaders	0.86	4.80	10.30	1.29	0.86
Rubber Tired Dozers	0.86	2.80	9.60	0.66	0.93
Tractors/Loaders/Backhoes	1.43	6.80	10.10	1.05	0.85
Crawler Tractors	1.29	4.80	10.30	1.15	0.85
Skid Steer Loaders	2.14	9.00	9.60	1.44	0.93
Off-Highway Tractors	2.51	14.68	11.91	2.03	0.93
Dumpers/Tenders	0.86	2.80	9.60	1.44	0.89
Other Construction Equipment	1.44	9.20	11.01	1.44	0.93
Industrial Equipment					
Aerial Lifts	1.60	6.06	14.00	1.60	0.93
Forklifts	1.60	6.06	14.00	1.60	0.93
Sweepers/Scrubbers	1.60	6.06	14.00	1.60	0.93
Other General Industrial Equipment	1.60	6.06	14.00	1.60	0.93
Other Material Handling Equipment	1.60	6.06	14.00	1.60	0.93
Lawn and Garden Equipment					
Rear Engine Riding Mowers	1.22	5.00	8.00	1.00	0.93
Lawn & Garden Tractors	1.22	5.00	8.00	1.00	0.93
Wood Splitters	1.22	5.00	8.00	1.00	0.93
Chippers/Stump Grinders	1.22	5.00	8.00	1.00	0.93

Table 7-7. Criteria Pollutant Emission Factors for Specific Types of Nonroad Diesel Vehicles/Equipment[a,b] (Cont'd)

Description	Emission Factors (g/hp-hr)				
	VOC[c]	CO	NO_X	PM	SO_X
Other Lawn & Garden Equipment	1.22	5.00	8.00	1.00	0.93
Agricultural Equipment					
Agricultural Tractors	2.27	8.94	11.21	2.05	0.87
Sprayers	2.27	3.78	7.78	1.51	0.92
Tillers > 5 hp	1.22	5.00	8.00	1.00	0.92
Hydro Power Units	2.27	3.78	7.78	1.51	0.92
Other Agricultural Equipment	1.86	4.37	11.12	1.51	0.92
Commercial Equipment					
Generator Sets < 50 hp	1.22	5.00	8.00	1.00	0.93
Pumps < 50 hp	1.22	5.00	8.00	1.00	0.93
Air Compressors < 50 hp	1.22	5.00	8.00	1.00	0.93
Welders < 50 hp	1.22	5.00	8.00	1.00	0.93
Pressure Washers < 50 hp	1.22	5.00	8.00	1.00	0.93
Logging Equipment					
Skidders	0.86	5.20	11.30	1.44	0.95
Fellers/Bunchers	0.86	5.20	11.30	1.44	0.95
Airport Ground Support					
Aircraft Support Equipment	1.60	6.06	14.00	1.60	0.93
Terminal Tractors	1.60	6.06	14.00	1.60	0.93

[a] Values in this table should be used when specified in Table 7.6 (i.e., for units with a pre 1988 model year and a horsepower rating > 50 hp).

[b] Values in this table are from Table 2-07 of Reference 8.

[c] Based on the sum of exhaust and crankcase hydrocarbons.

Table 7-8. General Emission Factors For Uncontrolled Gasoline Industrial Engines[a]

Pollutant[b]	Emission Factor (g/gal)[c]	Emission Factor (g/hp-hr)[d]
CO	3,583	199
NO_X	93	5.0
PM[e]	5.7	0.327
PM_{10}[e]	5.7	0.327
SO_X	4.8	0.268
VOC[f]	173	9.8

[a] Applicable Source Classification Codes (SCCs) include 2-02-003-01 and 2-03-003-01.

[b] No emission factors are currently available for hazardous air pollutants emitted from this source category.

[c] Grams pollutant emitted per gallons of fuel burned. These emission factors are derived from values listed in the EPA's FIRE Program.

[d] Grams pollutant emitted per horsepower-hour (power output). These emission factors are derived from the values listed in the Section 3.3 of AP-42.

[e] All particulate is assumed to be less than 1 μm in size.

[f] Based on the emission factor for Total Organic Compounds (TOC).

Table 7-9. General Emission Factors For Uncontrolled Diesel Industrial Engines[a]

Pollutant	Emission Factor (g/gal)[b]	Emission Factor (g/hp-hr)[c]
Criteria Pollutants		
CO	59	3.03
NO_X	274	14
PM[d]	19.3	1.00
PM_{10}[d]	19.3	1.00
SO_X	18.0	0.93
VOC[e]	22.4	1.1
Hazardous Air Pollutants		
Acetaldehyde	0.048	0.0024
Acrolein	0.006	2.94E-04
Benzene	0.058	0.0029
1,3-Butadiene	0.002	1.24E-04
Formaldehyde	0.073	0.0038
Naphthalene	0.005	2.69E-04
Polycyclic Aromatic Hydrocarbons (PAH)[f]	0.010	5.4E-04
Toluene	0.025	0.0013
Xylenes	0.018	9.1E-04

[a] Applies to diesel reciprocating internal combustion engines with a rated power up to 600 horsepower. Applicable Source Classification Codes (SCCs) include 2-02-001-02 and 2-03-001-01.

[b] Grams pollutant emitted per gallon of fuel burned. These emission factors are derived from values listed in the EPA's FIRE program. A typical diesel fuel heating value of 0.137 MMBtu/gal was used when deriving the HAP emission factors.

[c] Grams pollutant emitted per horsepower-hour (power output). These emission factors are derived from values listed in Section 3.3 of AP-42. An average brake-specific fuel consumption (BSFC) value of 0.007 MMBtu/hp-hr was used when deriving the HAP emission factors.

[d] All particulate is assumed to be less than 1 μm in size.

[e] Based on the emission factor for Total Organic Compounds (TOC).

[f] For inventory purposes, assume PAH is the same as Polycyclic Organic Matter (POM).

Table 7-10. HAP Speciation of VOC Emissions from Nonroad Vehicles/Equipment[a]

Pollutant	Weight Percent Speciation by Engine Type		
	2-Stroke Gasoline Engines[b]	4-Stroke Gasoline Engines[b]	Diesel Engines
Acetaldehyde	0.166	0.410	7.43
Acrolein	0.03	0.07	1.15
Benzene	2.52	5.25	2.03
1,3-Butadiene	0.215	0.952	0.186
Ethylbenzene	2.40	1.98	0.310
Formaldehyde	0.254	1.17	14.96
Hexane	1.42	0.992	0.159
Methyl tert-butyl ether[c]	14.67	16.01	N/A
Polycyclic Organic Matter[d]	0.00166	0.00151	0.000627
Propionaldehyde	0.0247	0.188	0.985
Styrene	0.130	0.0758	0.0594
Toluene	9.78	7.18	1.50
Xylene	10.75	6.78	1.06

[a] All data in this table is from Reference 7. Each value reflects the weight percent of the applicable HAP in the VOC emissions emitted from the applicable engine type.

[b] With the exception of the values listed for methyl tert-butyl ether, all speciation values for gasoline engines are based on the use of "baseline" gasoline (e.g., gasoline which has not been oxygenated/reformulated).

[c] Methyl tert-butyl ether (MTBE) emissions are only applicable to engines running on gasoline which is oxygenated with MTBE (i.e., winter oxygenated gasoline or reformulated gasoline).

[d] The Polycyclic Organic Matter (POM) values are based on the total of 16 individual polycyclic aromatic hydrocarbons (PAHs).

Figure 7-1. Example Data Collection Form for Nonroad Vehicles/Equipment

Installation Name: **Inventory Year (CY):**
Responsible Organization (Name & Office Symbol):
POC (Name & Phone #):

Equipment Type	Equipment ID	Manufacturer	Model #	Fuel Type	Horsepower Rating (hp)	Load Factor (% of Max. Power) [if known]*	Estimated Operating Time (hr/yr)	Estimated Fuel Usage (gal/yr) [Optional]**

* The load factor is the highest % of maximum power which the equipment was operated at during the inventory year. If this is unknown, a default EPA value will be used.
** The quantity of fuel used by the equipment during the year is only needed if the horsepower rating and/or the estimated operating hours are not known.

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7.5 References

1. U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors - Volume I: Stationary Point and Area Sources* (AP-42), Section 3.3, October 1996.

2. U.S. Environmental Protection Agency, *Factor Information Retrieval System* (FIRE), Version 6.23, October 2000.

3. U.S. Environmental Protection Agency, *Emission Factor Documentation for AP-42 Section 3.3, Gasoline and Diesel Industrial Engines*, April 1993.

4. U.S. Environmental Protection Agency, Office of Mobile Sources, *Average Life, Annual Activity, and Load Factor Value for Nonroad Engine Emissions Modeling*, Report No. NR-005, December 1997.

5. U.S. Environmental Protection Agency, Office of Mobile Sources, *Exhaust Emission Factors for Nonroad Engine Modeling—Compression-Ignition*, Report No. NR-009A, February 1998 (Revised June 1998).

6. U.S. Environmental Protection Agency, Office of Mobile Sources, *Exhaust Emission Factors for Nonroad Engine Modeling—Spark-Ignition*, Report No. NR-010b, February 1998 (Revised March 1999).

7. Eastern Research Group, Inc., *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Mobile Sources*, June 2000.

8. U.S. Environmental Protection Agency, *Nonroad Engine and Vehicle Emission Study-Report*, November 1991.

SECTION 8

OTHER SOURCES

8.1 The previous sections of this document address the most common types of mobile sources found at Air Force installations. However, there are a few other types of mobile sources which should also be included in a mobile source air emissions inventory if applicable to the installation. These "other" source types include locomotives, marine vessels, and missiles/rockets. Since these source types are unique to just a small number of Air Force installations, they are not addressed in detail in this document. However, some general information about these sources, including where to find specific emissions data, is provided below. Please contact AFIERA/RSEA if additional information or assistance is required when addressing these sources.

a. Locomotives – A few installations in the Air Force still have active railroad lines which traverse across some portion of the installation. Therefore, emissions generated from locomotives during the time they are physically traveling within the installation property boundary should be included in a mobile source emissions inventory. Information pertaining to air emissions from locomotives can be found at the following EPA internet site: http://www.epa.gov/otaq/locomotv.htm. In addition, a section on locomotives can be found in the EPA's AP-42, Volume II document. A file containing the locomotive section of AP-42 (file name "ora00036.pdf") can be downloaded from the following internet site: http://www.epa.gov/otaq/models/ap42/.

b. Marine Vessels – A few Air Force installations have water recreational areas located on, or adjacent to, the installation. Therefore, emissions from motorized marine vessels (boats, personal water crafts, etc.) during the time they are operated within the installation property boundary should be included in a mobile source emissions inventory. Information pertaining to air emissions from both gasoline-fueled marine vessels and diesel-fueled marine vessels can be found at the following EPA internet sites, respectively: http://www.epa.gov/otaq/marinesi.htm and http://www.epa.gov/otaq/marine.htm. In addition, sections on inboard-powered vessels and outboard-powered vessels can be found in the EPA's AP-42, Volume II document. These sections are found in the same "ora00036.pdf" file cited above for locomotives.

c. Missiles/Rockets – A few Air Force installations are set up to conduct missile and/or rocket launches. As with aircraft, the emissions from missile/rocket launches which should be addressed in a mobile source inventory are those emissions which occur within the site specific mixing zone. Information pertaining to "mixing zone" can be found in the Aircraft Engine Emissions section (Section 3) of this document. The best approach for obtaining data needed to calculate launch vehicle emissions is to contact the applicable rocket motor/engine manufacturer. The rocket motor/engine manufacturer may be able to provide information such as fuel consumption rates and emission factors. Another possible method for estimating emissions from launch vehicles is through the use of computer models such as the Rocket Exhaust Effluent Diffusion Model (REEDM). REEDM and other similar models are used by the Air Force and the National Aeronautics

Space Administration (NASA) to characterize, and predict the behavior of, rocket engine exhaust clouds.

APPENDIX A

Definition of VOC

Definition of VOC as listed in 40 CFR 51.100

(s) *Volatile organic compounds (VOC)* means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

(1) This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity: methane; ethane; methylene chloride (dichloromethane); 1,1,1-trichloroethane (methyl chloroform); 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113); trichlorofluoromethane (CFC-11); dichlorodifluoromethane (CFC-12); chlorodifluoromethane (HCFC-22); trifluoromethane (HFC-23); 1,2-dichloro 1,1,2,2-tetrafluoroethane (CFC-114); chloropentafluoroethane (CFC-115); 1,1,1-trifluoro 2,2-dichloroethane (HCFC-123); 1,1,1,2-tetrafluoroethane (HFC-134a); 1,1-dichloro 1-fluoroethane (HCFC-141b); 1-chloro 1,1-difluoroethane (HCFC-142b); 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124); pentafluoroethane (HFC-125); 1,1,2,2-tetrafluoroethane (HFC-134); 1,1,1-trifluoroethane (HFC-143a); 1,1-difluoroethane (HFC-152a); parachlorobenzotrifluoride (PCBTF); cyclic, branched, or linear completely methylated siloxanes; acetone; perchloroethylene (tetrachloroethylene); 3,3-dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca); 1,3-dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb); 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC 43-10mee); difluoromethane (HFC-32); ethylfluoride (HFC-161); 1,1,1,3,3,3-hexafluoropropane (HFC-236fa); 1,1,2,2,3-pentafluoropropane (HFC-245ca); 1,1,2,3,3-pentafluoropropane (HFC-245ea); 1,1,1,2,3-pentafluoropropane (HFC-245eb); 1,1,1,3,3-pentafluoropropane (HFC-245fa); 1,1,1,2,3,3-hexafluoropropane (HFC-236ea); 1,1,1,3,3-pentafluorobutane (HFC-365mfc); chlorofluoromethane (HCFC-31); 1 chloro-1-fluoroethane (HCFC-151a); 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a); 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxy-butane ($C_4F_9OCH_3$); 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OCH_3$); 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane ($C_4F_9OC_2H_5$); 2-(ethoxydifluoromethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OC_2H_5$); methyl acetate and perfluorocarbon compounds which fall into these classes:

(i) Cyclic, branched, or linear, completely fluorinated alkanes;

(ii) Cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;

(iii) Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and

(iv) Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

(2) For purposes of determining compliance with emissions limits, VOC will be measured by the test methods in the approved State Implementation Plan (SIP) or 40 CFR part 60, appendix A, as applicable. Where such a method also measures compounds with negligible photochemical reactivity, these negligibly-reactive compounds may be excluded as VOC if the amount of such compounds is accurately quantified, and such exclusion is approved by the enforcement authority.

(3) As a precondition to excluding these compounds as VOC or at any time thereafter, the enforcement authority may require an owner or operator to provide monitoring or testing methods and results demonstrating, to the satisfaction of the enforcement authority, the amount of negligibly-reactive compounds in the source's emissions.

(4) For purposes of Federal enforcement for a specific source, the EPA shall use the test methods specified in the applicable EPA-approved SIP, in a permit issued pursuant to a program approved or promulgated under title V of the Act, or under 40 CFR part 51, subpart I or appendix S, or under 40 CFR

parts 52 or 60. The EPA shall not be bound by any State determination as to appropriate methods for testing or monitoring negligibly-reactive compounds if such determination is not reflected in any of the above provisions.

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APPENDIX B

Listings of Hazardous Air Pollutants (HAPs)

Hazardous Air Pollutants (Alphabetical Order)

CAS Number	Chemical Name
75-07-0	Acetaldehyde
60-35-5	Acetamide
75-05-8	Acetonitrile
98-86-2	Acetophenone
53-96-3	2-Acetylaminofluorene
107-02-8	Acrolein
79-06-1	Acrylamide
79-10-7	Acrylic acid
107-13-1	Acrylonitrile
107-05-1	Allyl chloride
92-67-1	4-Aminobiphenyl
62-53-3	Aniline
90-04-0	o-Anisidine
	Antimony Compounds
	Arsenic Compounds (inorganic including arsine)
1332-21-4	Asbestos
71-43-2	Benzene (including benzene from gasoline)
92-87-5	Benzidine
98-07-7	Benzotrichloride
100-44-7	Benzyl chloride
	Beryllium Compounds
92-52-4	Biphenyl
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)
542-88-1	Bis(chloromethyl)ether
75-25-2	Bromoform
106-99-0	1,3-Butadiene
	Cadmium Compounds
156-62-7	Calcium cyanamide
133-06-2	Captan
63-25-2	Carbaryl
75-15-0	Carbon disulfide
56-23-5	Carbon tetrachloride
463-58-1	Carbonyl sulfide
120-80-9	Catechol
133-90-4	Chloramben
57-74-9	Chlordane
7782-50-5	Chlorine
79-11-8	Chloroacetic acid
532-27-4	2-Chloroacetophenone
108-90-7	Chlorobenzene
510-15-6	Chlorobenzilate
67-66-3	Chloroform
107-30-2	Chloromethyl methyl ether

CAS Number	Chemical Name
126-99-8	Chloroprene
	Chromium Compounds
	Cobalt Compounds
	Coke Oven Emissions
1319-77-3	Cresols/Cresylic acid (isomers and mixture)
95-48-7	o-Cresol
108-39-4	m-Cresol
106-44-5	p-Cresol
98-82-8	Cumene
	Cyanide Compounds[1]
94-75-7	2,4-D, salts and esters
3547-04-4	DDE
334-88-3	Diazomethane
132-64-9	Dibenzofurans
96-12-8	1,2-Dibromo-3-chloropropane
84-74-2	Dibutylphthalate
106-46-7	1,4-Dichlorobenzene(p)
91-94-1	3,3-Dichlorobenzidene
111-44-4	Dichloroethyl ether (Bis(2-chloroethyl)ether)
542-75-6	1,3-Dichloropropene
62-73-7	Dichlorvos
111-42-2	Diethanolamine
121-69-7	N,N-Diethyl aniline (N,N-Dimethylaniline)
64-67-5	Diethyl sulfate
119-90-4	3,3-Dimethoxybenzidine
60-11-7	Dimethyl aminoazobenzene
119-93-7	3,3'-Dimethyl benzidine
79-44-7	Dimethyl carbamoyl chloride
68-12-2	Dimethyl formamide
57-14-7	1,1-Dimethyl hydrazine
131-11-3	Dimethyl phthalate
77-78-1	Dimethyl sulfate
534-52-1	4,6-Dinitro-o-cresol, and salts
51-28-5	2,4-Dinitrophenol
121-14-2	2,4-Dinitrotoluene
123-91-1	1,4-Dioxane (1,4-Diethyleneoxide)
122-66-7	1,2-Diphenylhydrazine
106-89-8	Epichlorohydrin (l-Chloro-2,3-epoxypropane)
106-88-7	1,2-Epoxybutane
140-88-5	Ethyl acrylate
100-41-4	Ethyl benzene
51-79-6	Ethyl carbamate (Urethane)
75-00-3	Ethyl chloride (Chloroethane)
106-93-4	Ethylene dibromide (Dibromoethane)
107-06-2	Ethylene dichloride (1,2-Dichloroethane)

CAS Number	Chemical Name
107-21-1	Ethylene glycol
151-56-4	Ethylene imine (Aziridine)
75-21-8	Ethylene oxide
96-45-7	Ethylene thiourea
75-34-3	Ethylidene dichloride (1,1-Dichloroethane)
50-00-0	Formaldehyde
	Glycol ethers[2]
76-44-8	Heptachlor
118-74-1	Hexachlorobenzene
87-68-3	Hexachlorobutadiene
77-47-4	Hexachlorocyclopentadiene
67-72-1	Hexachloroethane
822-06-0	Hexamethylene-1,6-diisocyanate
680-31-9	Hexamethylphosphoramide
110-54-3	Hexane
302-01-2	Hydrazine
7647-01-0	Hydrochloric acid
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)
123-31-9	Hydroquinone
78-59-1	Isophorone
	Lead Compounds
58-89-9	Lindane (all isomers)
108-31-6	Maleic anhydride
	Manganese Compounds
	Mercury Compounds
67-56-1	Methanol
72-43-5	Methoxychlor
74-83-9	Methyl bromide (Bromomethane)
74-87-3	Methyl chloride (Chloromethane)
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)
78-93-3	Methyl ethyl ketone (2-Butanone)
60-34-4	Methyl hydrazine
74-88-4	Methyl iodide (Iodomethane)
108-10-1	Methyl isobutyl ketone (Hexone)
624-83-9	Methyl isocyanate
80-62-6	Methyl methacrylate
1634-04-4	Methyl tert butyl ether
101-14-4	4,4-Methylene bis(2-chloroaniline)
75-09-2	Methylene chloride (Dichloromethane)
101-68-8	Methylene diphenyl diisocyanate (MDI)
101-77-9	4,4'-Methylenedianiline
	Mineral fibers (fine)[3]
91-20-3	Naphthalene
	Nickel Compounds
98-95-3	Nitrobenzene

CAS Number	Chemical Name
92-93-3	4-Nitrobiphenyl
100-02-7	4-Nitrophenol
79-46-9	2-Nitropropane
684-93-5	N-Nitroso-N-methylurea
62-75-9	N-Nitrosodimethylamine
59-89-2	N-Nitrosomorpholine
56-38-2	Parathion
82-68-8	Pentachloronitrobenzene (Quintobenzene)
87-86-5	Pentachlorophenol
108-95-2	Phenol
106-50-3	p-Phenylenediamine
75-44-5	Phosgene
7803-51-2	Phosphine
7723-14-0	Phosphorus
85-44-9	Phthalic anhydride
1336-36-3	Polychlorinated biphenyls (Aroclors)
	Polycylic Organic Matter[4]
1120-71-4	1,3-Propane sultone
57-57-8	beta-Propiolactone
123-38-6	Propionaldehyde
114-26-1	Propoxur (Baygon)
78-87-5	Propylene dichloride (1,2-Dichloropropane)
75-56-9	Propylene oxide
75-55-8	1,2-Propylenimine (2-Methyl aziridine)
91-22-5	Quinoline
106-51-4	Quinone
	Radionuclides (including radon)[5]
	Selenium Compounds
100-42-5	Styrene
96-09-3	Styrene oxide
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin
79-34-5	1,1,2,2-Tetrachloroethane
127-18-4	Tetrachloroethylene (Perchloroethylene)
7550-45-0	Titanium tetrachloride
108-88-3	Toluene
95-80-7	2,4-Toluene diamine
584-84-9	2,4-Toluene diisocyanate
95-53-4	o-Toluidine
8001-35-2	Toxaphene (chlorinated camphene)
120-82-1	1,2,4-Trichlorobenzene
79-00-5	1,1,2-Trichloroethane
79-01-6	Trichloroethylene
95-95-4	2,4,5-Trichlorophenol
88-06-2	2,4,6-Trichlorophenol
121-44-8	Triethylamine

CAS Number	Chemical Name
1582-09-8	Trifluralin
540-84-1	2,2,4-Trimethylpentane
108-05-4	Vinyl acetate
593-60-2	Vinyl bromide
75-01-4	Vinyl chloride
75-35-4	Vinylidene chloride (1,1-Dichloroethylene)
1330-20-7	Xylenes (isomers and mixture)
95-47-6	o-Xylenes
108-38-3	m-Xylenes
106-42-3	p-Xylenes

NOTE: For all listings above which contain the word "compounds" and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical's infrastructure.

[1]X'CN where X = H' or any other group where a formal dissociation may occur. For example KCN or $Ca(CN)_2$

[2]Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol $R-(OCH2CH2)_n-OR'$ where:

n = 1, 2, or 3

R = alkyl or aryl groups

R' = R, H, or groups which, when removed, yield glycol ethers with the structure: $R-(OCH2CH)_n-OH$. Polymers are excluded from the glycol category.

[3]Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

[4]Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100°C.

[5]A type of atom which spontaneously undergoes radioactive decay.

Hazardous Air Pollutants (CAS Number Order)

CAS Number	Chemical Name
50-00-0	Formaldehyde
51-28-5	2,4-Dinitrophenol
51-79-6	Ethyl carbamate (Urethane)
53-96-3	2-Acetylaminofluorene
56-23-5	Carbon tetrachloride
56-38-2	Parathion
57-14-7	1,1-Dimethyl hydrazine
57-57-8	beta-Propiolactone
57-74-9	Chlordane
58-89-9	Lindane (all isomers)
59-89-2	N-Nitrosomorpholine
60-11-7	Dimethyl aminoazobenzene
60-34-4	Methyl hydrazine
60-35-5	Acetamide
62-53-3	Aniline
62-73-7	Dichlorvos
62-75-9	N-Nitrosodimethylamine
63-25-2	Carbaryl
64-67-5	Diethyl sulfate
67-56-1	Methanol
67-66-3	Chloroform
67-72-1	Hexachloroethane
68-12-2	Dimethyl formamide
71-43-2	Benzene (including benzene from gasoline)
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)
72-43-5	Methoxychlor
74-83-9	Methyl bromide (Bromomethane)
74-87-3	Methyl chloride (Chloromethane)
74-88-4	Methyl iodide (Iodomethane)
75-00-3	Ethyl chloride (Chloroethane)
75-01-4	Vinyl chloride
75-05-8	Acetonitrile
75-07-0	Acetaldehyde
75-09-2	Methylene chloride (Dichloromethane)
75-15-0	Carbon disulfide
75-21-8	Ethylene oxide
75-25-2	Bromoform
75-34-3	Ethylidene dichloride (1,1-Dichloroethane)
75-35-4	Vinylidene chloride (1,1-Dichloroethylene)
75-44-5	Phosgene
75-55-8	1,2-Propylenimine (2-Methyl aziridine)
75-56-9	Propylene oxide
76-44-8	Heptachlor

CAS Number	Chemical Name
77-47-4	Hexachlorocyclopentadiene
77-78-1	Dimethyl sulfate
78-59-1	Isophorone
78-87-5	Propylene dichloride (1,2-Dichloropropane)
78-93-3	Methyl ethyl ketone (2-Butanone)
79-00-5	1,1,2-Trichloroethane
79-01-6	Trichloroethylene
79-06-1	Acrylamide
79-10-7	Acrylic acid
79-11-8	Chloroacetic acid
79-34-5	1,1,2,2-Tetrachloroethane
79-44-7	Dimethyl carbamoyl chloride
79-46-9	2-Nitropropane
80-62-6	Methyl methacrylate
82-68-8	Pentachloronitrobenzene (Quintobenzene)
84-74-2	Dibutylphthalate
85-44-9	Phthalic anhydride
87-68-3	Hexachlorobutadiene
87-86-5	Pentachlorophenol
88-06-2	2,4,6-Trichlorophenol
90-04-0	o-Anisidine
91-20-3	Naphthalene
91-22-5	Quinoline
91-94-1	3,3-Dichlorobenzidene
92-52-4	Biphenyl
92-67-1	4-Aminobiphenyl
92-87-5	Benzidine
92-93-3	4-Nitrobiphenyl
94-75-7	2,4-D, salts and esters
95-47-6	o-Xylenes
95-48-7	o-Cresol
95-53-4	o-Toluidine
95-80-7	2,4-Toluene diamine
95-95-4	2,4,5-Trichlorophenol
96-09-3	Styrene oxide
96-12-8	1,2-Dibromo-3-chloropropane
96-45-7	Ethylene thiourea
98-07-7	Benzotrichloride
98-82-8	Cumene
98-86-2	Acetophenone
98-95-3	Nitrobenzene
100-02-7	4-Nitrophenol
100-41-4	Ethyl benzene
100-42-5	Styrene
100-44-7	Benzyl chloride

CAS Number	Chemical Name
101-14-4	4,4-Methylene bis(2-chloroaniline)
101-68-8	Methylene diphenyl diisocyanate (MDI)
101-77-9	4,4¬-Methylenedianiline
106-42-3	p-Xylenes
106-44-5	p-Cresol
106-46-7	1,4-Dichlorobenzene(p)
106-50-3	p-Phenylenediamine
106-51-4	Quinone
106-88-7	1,2-Epoxybutane
106-89-8	Epichlorohydrin (l-Chloro-2,3-epoxypropane)
106-93-4	Ethylene dibromide (Dibromoethane)
106-99-0	1,3-Butadiene
107-02-8	Acrolein
107-05-1	Allyl chloride
107-06-2	Ethylene dichloride (1,2-Dichloroethane)
107-13-1	Acrylonitrile
107-21-1	Ethylene glycol
107-30-2	Chloromethyl methyl ether
108-05-4	Vinyl acetate
108-10-1	Methyl isobutyl ketone (Hexone)
108-31-6	Maleic anhydride
108-38-3	m-Xylenes
108-39-4	m-Cresol
108-88-3	Toluene
108-90-7	Chlorobenzene
108-95-2	Phenol
110-54-3	Hexane
111-42-2	Diethanolamine
111-44-4	Dichloroethyl ether (Bis(2-chloroethyl)ether)
114-26-1	Propoxur (Baygon)
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)
118-74-1	Hexachlorobenzene
119-90-4	3,3-Dimethoxybenzidine
119-93-7	3,3¬-Dimethyl benzidine
120-80-9	Catechol
120-82-1	1,2,4-Trichlorobenzene
121-14-2	2,4-Dinitrotoluene
121-44-8	Triethylamine
121-69-7	N,N-Diethyl aniline (N,N-Dimethylaniline)
122-66-7	1,2-Diphenylhydrazine
123-31-9	Hydroquinone
123-38-6	Propionaldehyde
123-91-1	1,4-Dioxane (1,4-Diethyleneoxide)
126-99-8	Chloroprene
127-18-4	Tetrachloroethylene (Perchloroethylene)

CAS Number	Chemical Name
131-11-3	Dimethyl phthalate
132-64-9	Dibenzofurans
133-06-2	Captan
133-90-4	Chloramben
140-88-5	Ethyl acrylate
151-56-4	Ethylene imine (Aziridine)
156-62-7	Calcium cyanamide
302-01-2	Hydrazine
334-88-3	Diazomethane
463-58-1	Carbonyl sulfide
510-15-6	Chlorobenzilate
532-27-4	2-Chloroacetophenone
534-52-1	4,6-Dinitro-o-cresol, and salts
540-84-1	2,2,4-Trimethylpentane
542-75-6	1,3-Dichloropropene
542-88-1	Bis(chloromethyl)ether
584-84-9	2,4-Toluene diisocyanate
593-60-2	Vinyl bromide
624-83-9	Methyl isocyanate
680-31-9	Hexamethylphosphoramide
684-93-5	N-Nitroso-N-methylurea
822-06-0	Hexamethylene-1,6-diisocyanate
1120-71-4	1,3-Propane sultone
1319-77-3	Cresols/Cresylic acid (isomers and mixture)
1330-20-7	Xylenes (isomers and mixture)
1332-21-4	Asbestos
1336-36-3	Polychlorinated biphenyls (Aroclors)
1582-09-8	Trifluralin
1634-04-4	Methyl tert butyl ether
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin
3547-04-4	DDE
7550-45-0	Titanium tetrachloride
7647-01-0	Hydrochloric acid
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)
7723-14-0	Phosphorus
7782-50-5	Chlorine
7803-51-2	Phosphine
8001-35-2	Toxaphene (chlorinated camphene)
	Antimony Compounds
	Arsenic Compounds (inorganic including arsine)
	Beryllium Compounds
	Cadmium Compounds
	Chromium Compounds
	Cobalt Compounds
	Coke Oven Emissions

CAS Number	Chemical Name
	Cyanide Compounds[1]
	Glycol ethers[2]
	Lead Compounds
	Manganese Compounds
	Mercury Compounds
	Fine mineral fibers[3]
	Nickel Compounds
	Polycylic Organic Matter[4]
	Radionuclides (including radon)[5]
	Selenium Compounds

NOTE: For all listings above which contain the word "compounds" and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical's infrastructure.

[1]X'CN where X = H' or any other group where a formal dissociation may occur. For example KCN or $Ca(CN)_2$

[2]Includes mono- and di- ethers of ethylene glycol, diethylene glycol, and triethylene glycol $R-(OCH2CH2)_n-OR'$ where:

n = 1, 2, or 3

R = alkyl or aryl groups

R' = R, H, or groups which, when removed, yield glycol ethers with the structure: $R-(OCH2CH)_n-OH$. Polymers are excluded from the glycol category.

[3]Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less.

[4]Includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100°C.

[5]A type of atom which spontaneously undergoes radioactive decay.

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APPENDIX C

Air Emissions Inventory Data Elements for Mobile Sources

Source Type	Data Elements
Aerospace Ground Equipment (Non-Vehicular)	1. AGE application (i.e., model number and equipment type) 2. Type of fuel used 3. Manufacturer, model number, and horsepower rating of the engine **At least one of the two alternative sets of data will also be required** **Option 1** 4. Quantity of fuel burned during the year (gal/yr) 5. Btu per horsepower-hour conversion for the AGE (Btu/hp-hr) [Note - If unknown, a typical value of 7,500 can be used] **Option 2** 6. Typical load the engine operates at 7. Total operating time during the year (hr/yr)
Aircraft Engine Emissions (On Wing Engine Testing)	1. Type of engine tested (i.e., model number) 2. Type of fuel used (e.g., JP-8, JP-5, etc.) 3. The different power settings the engine was tested at during the year (e.g., idle, approach, intermediate, military, afterburner, etc.) 4. The average fuel flow rate for each power setting the engine was tested at 5. The annual time the engine was tested at each power setting (hr/yr) **Note – If these annual test times are known, skip to Data Element No. 8, otherwise, go to Data Element No. 6** 6. The number of tests performed on the engine during the year 7. The approximate time at each power setting (min) 8. Sulfur content of the fuel (%)
Aircraft Engine Emissions (Auxiliary Power Units)	1. Auxiliary Power Unit (APU) type (i.e., model number) 2. Type of fuel used (e.g., JP-8, JP-5, etc.) 3. The different power settings the APU was operated at during the year (e.g., no load, maximum load, etc.) 4. The average fuel flow rate for each power setting the APU was operated at 5. The annual operating time at each applicable power setting (hr/yr) 6. Sulfur content of the fuel (%)

Source Type	Data Elements
Aircraft Engine Emissions (Aircraft Flying Operations)	Landing and Takeoff (LTO) Emissions 1. Type of aircraft conducting LTO cycles at the installation 2. Type of engine on the aircraft (model number) 3. Type of fuel used (e.g., JP-8, JP-5, Jet A, etc.) 4. Number of engines on the aircraft 5. The typical power setting used during the "Approach" mode of the LTO cycle 6. The typical power setting used during the "Taxi/Idle-in" mode of the LTO cycle 7. The typical power setting used during the "Taxi/Idle-out" mode of the LTO cycle 8. The typical power setting used during the "Takeoff" mode of the LTO cycle 9. The typical power setting used during the "Climbout" mode of the LTO cycle 10. The average fuel flow rate (per engine) used during each of the LTO cycle modes 11. The average amount of time the aircraft spends in each LTO cycle mode during a single LTO cycle (min/cycle) 12. The number of LTO cycles conducted at the installation during the year by this type of aircraft (cycles/yr) Touch and Go (TGO) and Low Flyby (LFB) Emissions 1. The data elements needed to calculate emissions from TGO and LFB operations are similar to the data elements listed above for calculating LTO emissions, except the "Taxi/Idle-in" and "Taxi/Idle-out" modes are not addressed (i.e., the term "LTO cycle" would be replaced with either "TGO cycle" or "LFB cycle" (as applicable) and Data Elements 6 and 7 would be removed) Low Flight Pattern (LFP) Emissions (Within Base Air Space) 1. Type of aircraft conducting LFP flights within base air space 2. Type of engine on the aircraft (model number) 3. Type of fuel used (e.g., JP-8, JP-5, Jet A, etc.) 4. Number of engines on the aircraft 5. The average time the aircraft is within base air space during each LFP flight 6. The typical power setting used by the aircraft when flying a LFP within base air space 7. The average fuel flow rate (per engine) used during each LFP within base air space 8. The number of LFP flights conducted within base air space during the year by this type of aircraft

Source Type	Data Elements
Aircraft Engine Emissions (Aircraft Flying Operations – Continued)	Low Flight Pattern (LFP) Emissions (Outside Base Air Space) 1. The data elements needed to calculate emissions from LFP flights outside base air space are similar to the data elements listed above for calculating emissions from LFP flights within base air space, except "within base air space" is replaced with "within air space adjacent to the base"

Source Type	Data Elements
On-Road Vehicles (Government Owned)	1. Listing(s) of all government owned on-road vehicles used on the installation [Note - include vehicle identification number (VIN), if possible. If the VIN is unavailable, include some other designation unique to the vehicle] 2. The applicable category each government owned vehicle (GOV) falls under (i.e., LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, or Alternative Fueled Vehicle (AFV)) [Note – this is usually determined based on the fuel type, the gross vehicle weight (GVW), and in some cases, whether or not the vehicle is classified as a "truck"] 3. Model Year for each GOV 4. Estimated number of miles each vehicle traveled on base during the year (mi/yr) 5. Altitude (feet above sea level) at the base location 6. Typical sulfur content of the fuel used [Note – if unknown, default values listed in Section 4 of this guidance document can be used] 7. Typical lead content of gasoline used [Note – if unknown, a default value listed in Section 4 of this guidance document can be used] 8. For idling vehicles only (i.e., vehicles which spend most of their operating time on base in the idle mode), the estimated time the vehicle spent idling on base during the year (hr/yr) **The following additional information is required for calculating fugitive particulate matter emissions** 9. Typical Road Surface Silt Loading of the paved roads on base (g/m^2) [Note - if unknown, a default value listed in Section 4 of this guidance document can be used] 10. Estimated average weight of vehicles traveling the paved roads on base (tons) [Note – if unknown, default values (by vehicle category) listed in Section 4 of this guidance document can be used to calculate an average weight] 11. Estimated average weight of vehicles traveling the unpaved roads on base (tons) [Note – if unknown, default values (by vehicle category) listed in Section 4 of this guidance document can be used to calculate an average weight] 12. For unpaved roads only, the estimated average Surface Material Silt Content (%) [Note – if unknown, default values listed in Section 4 of this guidance document can be used] 13. For unpaved roads only, the estimated average Surface Material Moisture Content under dry, uncontrolled conditions [Note – if unknown, a default value listed in Section 4 of this guidance document can be used] 14. For calculating fugitive PM emissions from unpaved roads, the number of days during the year in which the base received at least 0.01 inches of precipitation

Source Type	Data Elements
On-Road Vehicles (Privately Owned)	1. Need to know the estimated average number of registered vehicles (at the installation during the inventory year) which fall under each of the eight vehicle categories (i.e., LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and Motorcycles (MC)), as well as the average Model Year for each vehicle category. This may be accomplished using one of the two alternative methods: **Option 1** If available, obtain (from Pass & Registration or MPF) a listing of the registered vehicles on base, and if possible, segregate these vehicles by vehicle type category (i.e., LDGV, LDGT1, etc.) and Model Year **Option 2** Obtain (from Pass & Registration or MPF) an estimate of the average number of registered vehicles at the installation, and the estimated percentage of these vehicles which fall under each of the eight different vehicle categories (i.e., LDGV, LDGT1, etc.) 2. The estimated percentage of registered vehicles which actually travel on base during a typical weekday and during a typical weekend day 3. The estimated distance (miles) the average privately owned vehicle (POV) travels on base during a typical weekday and during a typical weekend day 4. The estimated number of non-registered vehicles traveling on base during a typical weekday and during a typical weekend day 5. Altitude (feet above sea level) at the base location 6. If fugitive particulate matter emissions need to be calculated, then the fugitive particulate matter data elements listed above for Government Owned On-Road Vehicles (i.e., Data Elements 9 through 14) will also be applicable to Privately Owned On-Road Vehicles

Source Type	Data Elements
Nonroad Vehicles/Equipment	1. Type of nonroad vehicle/equipment (e.g., forklift, backhoe, lawnmower, paving equipment, etc.) 2. Rated power output of the engine associated with the vehicle/equipment (hp) 3. Type of fuel used by the vehicle/equipment 4. If the vehicle/equipment is gasoline-fueled, the type of engine combustion cycle (i.e., 4-stroke or 2-stroke) **At least one of the two alternative sets of data will also be required** **Option 1** 5. Estimated time the vehicle/equipment was in operation during the year (hr/yr) 6. Typical "Percent of Maximum Power" the vehicle/equipment is run at (i.e., Typical Loading Factor) [Note – if unknown, default values listed in Section 7 of this guidance document can be used] **Option 2** 7. Estimated quantity of fuel consumed by the vehicle/equipment during the year (gal/yr) 8. Density of the fuel (lb/gal) [Note – if unknown, default values listed in Section 7 of this guidance document can be used] 9. Typical Brake-Specific Fuel Consumption (BSFC) associated with the vehicle/equipment (lb/hp-hr) [Note – if unknown, default values listed in Section 7 of this guidance document can be used]

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APPENDIX D

Example of an Aircraft Flightline Operations Survey

AIRCRAFT FLIGHTLINE OPERATIONS EMISSIONS SURVEY

Aircraft landing and takeoff (LTO), touch and go (TGO), low fly by (LFB), and low flight pattern (LFP) operations can be a significant source of air pollution emissions at an Air Force base. To quantify these emissions, base specific data is needed on aircraft operations and meteorological conditions.

LTO emissions are based on the number of LTO cycles, aircraft model, aircraft engine model, amount of time spent in each operational mode (i.e., approach, taxi/idle-in, taxi/ide-out, takeoff, climbout), power setting used during each operational mode, the fuel flowrate at each power setting, and the average atmospheric mixing height. Each aircraft type may have a unique LTO scenario. The amount of time spent in each operational mode and the fuel flowrates for each power setting are typically different for each aircraft model/type.

Aircraft TGO cycles can also contribute significant quantities of pollution. TGO emissions are calculated in the same manner as LTO emissions, except the taxi/idle-in and taxi/idle-out operational modes are not included.

LFB cycles are similar to TGO cycles except the aircraft does not touch the ground during a LFB. In addition, the time spent in each operational mode may be slightly different.

Low flight patterns (LFPs) are those designed flights that occur (mainly for training purposes) below the average atmospheric mixing height. It's important to differentiate between flight patterns that occur over the base and those that occur in other areas (i.e., outside the base air space). The power setting used during these flights is typically either intermediate or military.

Definitions:

Average Atmospheric Mixing Zone Height – The "Mixing Zone" is the layer of the earth's atmosphere where chemical reactions of pollutants can ultimately affect ground level pollutant concentrations. The "Average Mixing Zone Height" is also known as the average height of the inversion layer.

Landing and Takeoff Cycle Modes – There are five operational modes in a LTO cycle:

- **Approach** - Measured from the time the aircraft enters the atmospheric mixing zone until the aircraft lands. The engine power setting usually associated with this mode is the "approach" power setting.
- **Taxi/Idle-in** - Time spent after landing until the aircraft is parked and turned off. The engine power setting usually associated with this mode is the "idle" power setting.
- **Taxi/Idle-out** - Period from engine startup to takeoff. The power setting usually associated with this mode is the "idle" power setting.
- **Takeoff** - Characterized by full-throttle operation that lasts until the aircraft reaches an altitude of 500 to 1000 feet. The power setting usually associated with this mode is either the "military" or "afterburner" power setting.
- **Climbout** - The period following takeoff that concludes when the aircraft passes out of the mixing zone. The power setting usually associated with this mode is the "intermediate" power setting.

The Approach, Takeoff, and Climbout modes also apply to TGOs and LFBs.

The most accurate method for calculating LTO, TGO, LFB, and LFP emissions involves the use of actual operational and base specific data. Therefore, please have the operational wings for each type of aircraft based at (*base name*) complete the attached questionnaire. If you have any questions, please contact (*persons name and telephone number*).

AIRCRAFT FLIGHTLINE OPERATIONAL DATA

1. Organization: _____, Contact: _____

2. Telephone Number (DSN): _____

3. Aircraft Model: _____

4. Number of Engines: _____

5. Engine Model Number: _____

6. (*Base name*) Average Atmospheric Mixing Height: _____ (Feet)

7. For Calendar Year: _____
   Number of Landing and Takeoff (LTO) Cycles: _____
   Number of Touch and Go (TGO) Cycles: _____
   Number of Low Fly By (LFB) Cycles: _____
   Number of Low Flight Patterns (LFPs): _____ (within base air space)
   Number of Low Flight Patterns (LFPs): _____ (outside base air space) [note – data on LFPs outside base air space is only required if specifically requested]

[Please enter the average time (minutes) spent in each mode for the LTOs, TGOs, LFBs, and LFPs applicable to the aircraft specified above. The times should take into account the average atmospheric mixing height and aircraft operation. Also provide the additional operational data requested below.]

8. LTO Time in Modes and Other Operational Data:

   - **Approach:** _____ (Minutes), Power Setting: _____,
     Percent of Total Thrust: _____, Fuel Flow Rate: _____ (lb/hr)
     Number of Engines Operating: _____.
   - **Taxi/Idle-in:** _____ (Minutes), Power Setting: _____,
     Percent of Total Thrust: _____, Fuel Flow Rate: _____ (lb/hr)
     Number of Engines Operating: _____.
   - **Taxi/Idle-out:** _____ (Minutes), Power Setting: _____,
     Percent of Total Thrust: _____, Fuel Flow Rate: _____ (lb/hr)
     Number of Engines Operating: _____.
   - **Takeoff** :_____ (Minutes), Power Setting: _____,
     Percent of Total Thrust: _____, Fuel Flow Rate: _____ (lb/hr)
     Number of Engines Operating: _____.
   - **Climb Out:** _____ (Minutes), Power Setting: _____,
     Percent of Total Thrust: _____, Fuel Flow Rate: _____ (lb/hr)
     Number of Engines Operating: _____.

(Continued on next page)

9. TGO Time in Modes and Other Operational Data:

- **Approach:** _____ (Minutes), Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.
- **Takeoff:** _____ (Minutes), Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating :_____.
- **Climb Out:** _____ (Minutes), Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.

10. LFB Time in Modes and Other Operational Data:

- **Approach:** _____ (Minutes), Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.
- **Takeoff:** _____ (Minutes), Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.
- **Climb Out:** _____ (Minutes), Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.

11. LFP Time and Other Operation Data (for LFPs within base air space):

- Average Time: _____ (Minutes), Typical Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.

12. LFP Time and Other Operation Data (for LFPs outside base air space):
[note – only provide if specifically requested]

- Average Time: _____ (Minutes), Typical Power Setting: _____,
  Percent of Total Thrust: _____,
  Number of Engines Operating: _____.

Auxiliary Power Units:

13. Is the aircraft equipped with an auxiliary power unit (APU)? Yes/No If Yes, please complete the following questions:

APU Model Number: _____, Number of APUs on Aircraft: _____.

Average length of time the APU operates while aircraft is on the ground: _____(Minutes).

Percent of time APU(s) operate Unloaded: _____, Loaded: _____.